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THE CHANGE OF FORM DURING GROWTH OF THE DAIRY COW.

The Change of Form during Growth of the Dairy Cow.

BY

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When arriving in South Africa in 1921, I had just finished the manuscript of a publication which was issued some time later by the "Vereeniging tot bevordering der Wetenschappelijke Teelt" in Holland containing the results of my researches about the change of form during growth in dairy cattle. In this rather voluminous publication of 200 pages all the measurements and calculations about proportions are published, allowing the reader to draw more conclusions and to go further in details than I could do in the few weeks left to me to write this manuscript.

Because a study of all the facts and figures collected in this publication, seems to me to be rather interesting for a greater number of scientific men than those who can read Dutch, and because American investigators have been collecting similar data about dairy cattle in America a couple of years ago, I decided to take this matter up once more and to discuss with the aid of graphical drawings the changes of form during growth of the dairy cow as illustrated by the figures collected during my researches in Holland.

A brief outline of the manner in which the different measurements were collected, may first be given.

At the farms of a dozen well-known breeders of Friesland cattle all the calves born during a certain time were measured at certain intervals during their growth. By grouping the calves,

200 in number, in groups of females and males according to the ages at which they were measured, I was able to obtain different groups of ascending ages, which average proportions of parts of the body gave a good insight in the changes taking place in these proportions during the development of the body.

Because all the calves lived in practically the same surroundings (the farms were all lying in a circle with a radius of about 5 miles), had the same feeding and enjoyed the same grazing, besides being more or less related, the individual variations were reduced to a minimum and even the sale of a good number of calves during the second half of the first year did not materially effect the reliability of the measurements and the averages.

However, to evade even this small chance of inaccuracy, I recomposed the groups again after the first half-year in groups, which instead of differing two weeks in age, differed a month in age, thus getting again a fair number of animals in every group.

The measurements, taken of every animal, consisted of :

The height at the withers.

The length of the body from shoulderpoint to pinbone.

The depth of the chest just behind the shoulder.

The width of the chest just behind the shoulder.

The width of the rump over the hips.

The width of the rump over the thurl.

The width of the rump over the pinbones.

The length of the rump from hip to pinbone.

The length of the lower part of the front leg from knee (from the os pisiforme) to the ground.

The length of the lower part of the hindleg from hock (from the top of the talus) to the ground.

The groups of the male calves are only measured during the first year of age because the practice of the Friesland breeder in Holland to sell his bulls as yearlings interfered so seriously with the results by leaving only a very small number of calves of over a year old available for measuring, that I considered this number too small for reliable results.

The females, however, are measured till they got their first calf. The total numbers of calves measured at certain ages are shown in the following tables:—

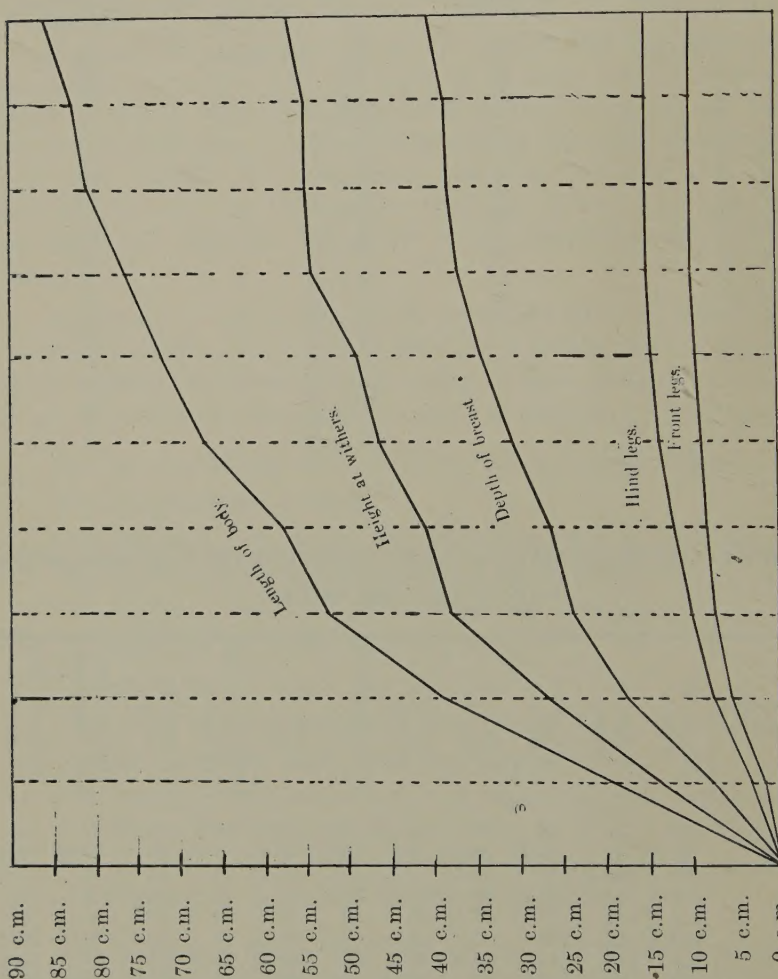
Age of Calves.	Number Measured.
0— 2 weeks.	18
2— 4 ,,	27
4— 6 ,,	31
6— 8 ,,	31
8—11 ,,	36
10—13 ,,	31
13—15 ,,	13
15—18 ,,	9
20—22 ,,	18
22—24 ,,	26
24—26 ,,	30
26—28 ,,	13
28—31 ,,	9

Age of Calves.	Number Measured.
6½— 7½ months.	13
7½— 8½ ,,	29
8½— 9½ ,,	30
9½—10½ ,,	11
11 —12 ,,	13
12 —13 ,,	29
13 —14 ,,	30
14 —15 ,,	10
15 —16 ,,	10
16 —17 ,,	18
17 —18 ,,	24
18 —19 ,,	8
19 —20 ,,	11
20 —21 ,,	21
21 —22 ,,	24
22 —23 ,,	8
26 —27 ,,	8
27 —28 ,,	15
28 —29 ,,	21
29 —30 ,,	6

TABLE I.—MEASUREMENTS IN CENTIMETRES OF THE DIFFERENT PARTS OF THE BODY.

Age of the Animals.	Height at withers.	Height at rump.	Length of body.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
At birth	74	77	69	29	16	17·5	21·5	5·5	23·5	27·5	40
¼ year	87·5	91	88·5	36·5	19·5	23·5	26·5	7·5	29	29·5	43·5
½ ,,	101	104	108	46·5	25·5	30	33	11	35	33	47·5
¾ ,,	112·5	116·5	121·5	53	28·5	35	37	13	38·5	35	50
1 ,,	115	119	127	55·5	29	38	38·5	14·5	40·5	36	52
1¼ ,,	120·5	125	136	60	33	42	42	16	43·5	36·5	53·5
1½ ,,	123	127	141	63·5	36	45	44	17·5	45	37	54·5
1¾ ,,	128·5	132	145·5	66	38	47	46	18	47·5	37·5	55
2 ,,	129	133	150	67	38	49	46·5	18·5	47·5	37·5	55
2¼ ,,	129	132	151·5	67·5	37·5	49	47	19	47·5	37·5	55
2½ ,,	131	135	155	67·5	38	50·5	48	19·5	48·5	37·5	55

FIG. I.—INCREASE IN CENTIMETERS DURING GROWTH.



From these measurements averages were caiculated to find the size of the different parts of the animal at birth, and at the ages of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2 $2\frac{1}{4}$ and $2\frac{1}{2}$ years.

In order to inquire into the proportions of these parts, the average measurements of the groups were also expressed in percentages of the height at the withers and in percentages of the length of the body.

In the table given below (Tab. I) are collected the actual dimensions in centimeters used to draw the graphs of Fig. I, II and III.

The Different Measurements during Growth.

Fig. 1. *Length of body.* The length of the body is taken as zero at the moment of birth and the graph give the differences, viz., the increases in length during the growth of the animal till it was $2\frac{1}{2}$ years old. Mention must be made that in the graph only the females are dealt with as has been done always in this article, the young bulls being too small in number to allow trustworthy averages to be calculated for the ages of one year and over. All the females had calved at about $2\frac{1}{4}$ years of age and were all in full milk and in fairly low condition when the experiment was stopped.

The body shows a quick increase in length during the first half year, while between threequarter and one year the increase is less than in adjoining periods. The custom in Holland to have the calves born in the early spring, to leave them out in the meadow when about 4 weeks and to keep them during the winter in the stable in pens, may be the cause, that the length of body does not show the same increase between $\frac{3}{4}$ years and $1\frac{1}{4}$ years as might be expected from the curve of the growth before that time. There is surely a peculiar concavity in this part of the curve, which indicates a smaller increase, due perhaps to lack of movement during the time the animals are stabled.

Beyond this peculiarity the curve of the increase in length of body is very regular, presenting a convex line, which shows clearly the decrease in intensity of growth as the animal grows older.

The height at the withers. A calf is higher than it is long, but the increase in height is smaller, displaying, however, generally the same peculiarities in connection with the stabling of the young animals.

Between $1\frac{1}{2}$ and $1\frac{3}{4}$ years there is a bigger increase in height than in the previous and following periods, which may be caused by a stimulating effect of the impregnation of the animals as exactly during this period most animals were served and became pregnant. Whether the stable-feeding or the stimulation from pregnancy is the reason of this phenomenon, which we will discuss later on more fully, cannot be decided till measurements of groups of animals are taken, some groups being kept outside in the meadow, some of the same average age being kept in the stable at the same time.

Except these irregularities the graph of the increase in height is very much alike the graph constructed for the increase in length with the only difference, that the absolute increase in every period is less and the graph consequently is less convex.

After calving there is a slight growth again, while during the months of pregnancy the increase in height is very small and is nil during the last three months.

Depth of chest. The chest develops quickly during the first half year, showing between $\frac{3}{4}$ and 1 year old the same decline in growth due perhaps to lack of movement during the time the animals were kept in the stable. From the age of one year the line representing the increase in depth of chest runs upwards very regularly to the time, at which the cows had calved while after calving a slight increase in depth again can be noted.

Hind legs and front legs. Taking both together, because both parts of the young animal show the same development throughout, it will be noted that the growth of the legs is very regular but very little and stops at a time at which all the other parts of the body already mentioned, are still growing considerably. It is interesting to calculate afterwards the rate of growth of these parts and to compare this rate for every period with the rates of growth of the other parts of the body as is done in Table II of this article, because these different rates give a clear idea

of the changes, which must take place in the dimensions of the different parts of the animals, causing the different general appearance of a mature animal as compared with that of a newly-born calf or a one-year-old heifer.

FIG. II.—INCREASE IN CENTIMETERS DURING GROWTH.

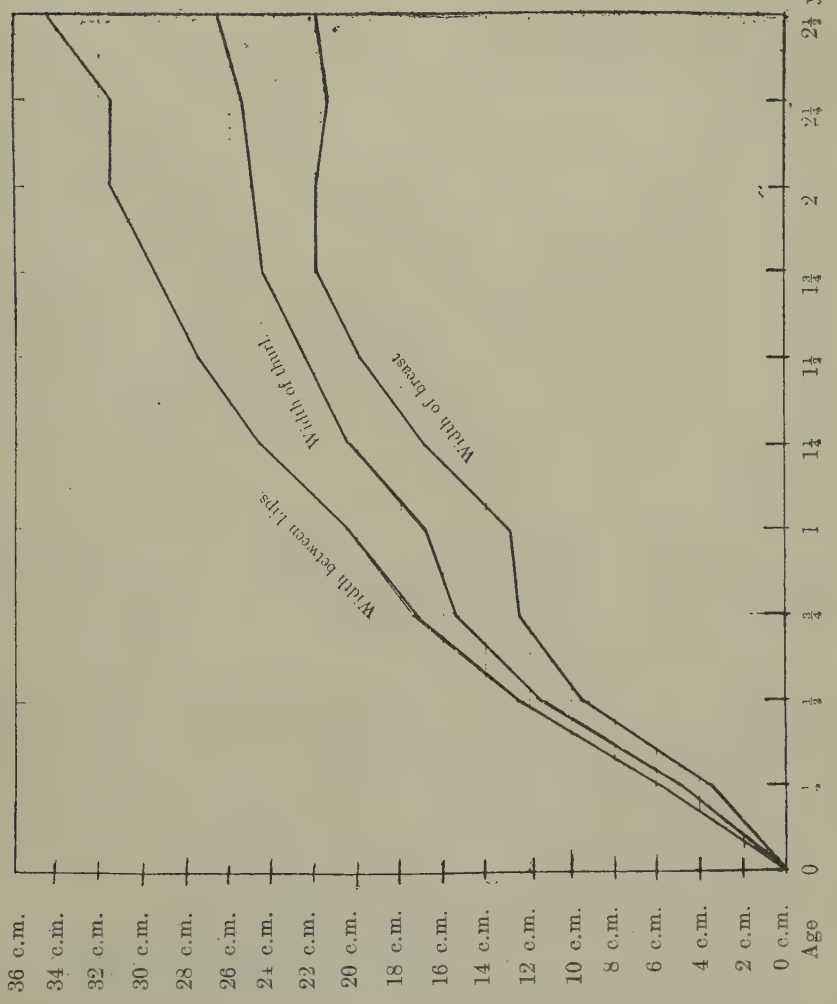


Fig. II. Attention must be drawn to the fact that this figure is made on another scale than Fig. I, every centimeter on the drawing representing 2 centimeter growth and not 5 centimeters growth as in Fig. I. It is for this reason impossible to compare the shape of the lines representing the growth of the parts mentioned in Fig. II with the shape of the lines in Fig. I.

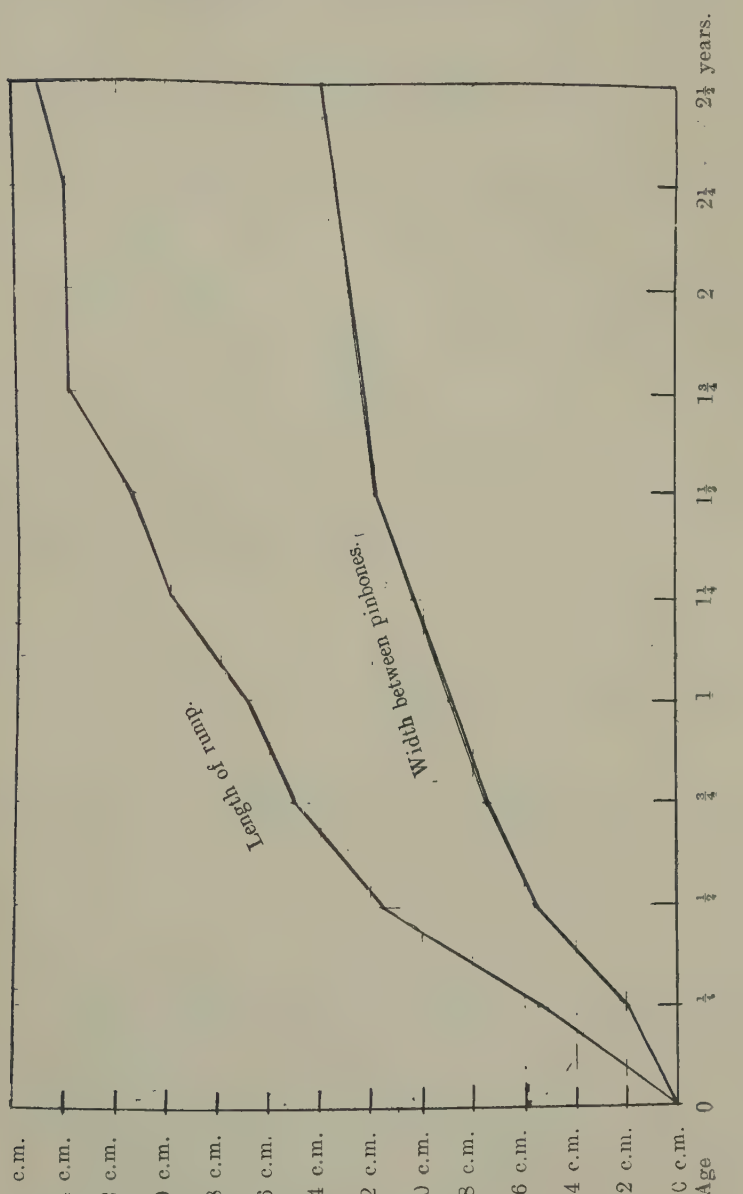
Width between the hips. This part of the animal body is very regular in development, the line representing this development, being nearly a regular convex line with the only exception of a slightly decreased growth between $\frac{3}{4}$ and 1 year and with a strong increase in growth after calving. The last increase is well marked on the graph being proceeded by a period in which no development of the width between the hips takes place. This period is the last period before calving and, as already mentioned, must rather be considered to be a period in the life of the animal in which every surplus of feed is used for the proper development of the foetus and the animal itself stops growing to a very great extent, which period is then afterwards followed by one in which the postponed growth of the animal itself takes place and the body seems to make up for the loss of time for growth incurred by the last phase of pregnancy.

The width of thurl. This measurement is not so much increasing as the width between the hips, which could be expected if one realises the great width of a calf over the thurl as compared with the width of the rump of the calf at the hipbones.

The development of this part of the body seems to be more affected by stabling than the previous part is, but during the period of pregnancy a fairly steady increase can be noted, followed by a slightly greater increase after calving. The irregularities, which the previous measurement tends to show, are here, however, far less marked.

The width of the chest. This quality is one of the most irregularly developing qualities of the animal and appears to be strongly influenced by movement and perhaps by fresh air for the young animal. One can clearly distinguish different periods in the growth of this part as

FIG. III.—INCREASE IN CENTIMETERS DURING GROWTH.



1. A period, wherein a very strong growth takes place, the period between birth and $\frac{3}{4}$ years old.

2. The period between $\frac{3}{4}$ years old and 1 year old wherein practically the growth of this part marks time.

3. A period between 1 year and $1\frac{3}{4}$ years characterised by a very regular development of the width of the chest.

4. The period of the last six months of pregnancy, resulting in a very small decrease or at least in no development at all in width of the chest. The decrease is usually caused by the loss of condition the animal shows just atfer calving and in the first weeks of the milk production.

5. The period after calving wherein the width of the chest regains its old dimension.

Discussing the change of the different parts in proportion to each other further demonstration will be given of the peculiar susceptibility of the development of the chest to the kind of treatment of the young animals.

Fig. III. Being drawn on the same scale, the graphs are very well comparable with those of Fig. II, but are not presented in the same figure to make the drawings less complicated.

The length of the rump. A steadily increasing feature without many irregularities, which stops increasing at an early age during the last half of the period of gestation and develops again slightly after calving.

The width between the pinbones. This measurement shows also a very regular increase represented by a slightly convex line, which indicates that the growth in the early periods of life is greater and becomes smaller with advancing age of the animal. Pregnancy seems to have no marked effect on this measurement.

Before proceeding to the discussion of the calculated rates of growth of the different parts and the change in proportions to each other, it may be of importance to compare the results of other investigators as far as direct increases in the size of these parts are concerned.

Eckles (1) published in 1920 the results of measurements of Friesland heifers, and though the number of animals is small, the fact that the same animals were taken renders his figures more accurate and adds to their reliability. The height at the withers and the weight were determined, and from the tables and the graphs published it can be easily seen that the curve representing the increase in height at withers runs very similar to our graph, with the exception that there are not, as in ours, the same irregularities, due to the stabling of the animals.

The increase in height of Eckles' animals is during the first 30 months 58.9 c.m., that of our animals being during the same time 57 c.m. The absolute figures for Eckles' animals are: height at birth 71.8 c.m., at 30 months 130.7 c.m., while our animals are at birth 74 c.m. high and at 30 months 131 c.m. Unfortunately Eckles does not give the highest and lowest measurement at birth of his animals, which makes his figure as an average rather inaccurate, and leaves the question open how many animals have contributed to the determination of the average size at birth.

Brody and Ragsdale (2 and 3) gave in 1924 and in 1925 some interesting data concerning the growth of dairy cattle, and from their data it appears that the height at the withers at birth of their Holstein animals was 70.4 c.m. and at 30 months 130.4 c.m.

About the course of their actual curves in the accompanying figures of this publication nothing can be said, and it is quite impossible to compare these curves with ours because the authors arrive at the smooth curves they publish by plotting these curves according to certain equations arrived at by calculating the decline in average rate of growth, which they consider to be fairly constant.

The method followed by them is derived from the calculation of the increase during a certain month expressed in percentages of the increase during the preceding month. They find that this figure, which they call the persistency of growth, is fairly constant for every month. By calculating this average persistency a formula can be found enabling the height at the withers to be determined for any age and the curve mentioned above to be plotted according to the calculated figures.

About the reliability of this method more will be said when dealing with the question of rates of growth of the different parts.

The depth of chest is found by the same authors to be 28.4 c.m. at birth and 67.5 c.m. at 30 months old, while our measurements for the same ages show respectively the figures 29 c.m. and 69.5 c.m., the Dutch animals being apparently as a rule slightly deeper than their American sisters.

For the width of the chest Brody and Ragsdale find 16.8 c.m. at birth and 41.6 c.m. at 30 months old, where we find 16 c.m. and 38 c.m. for the same quality, which proves the Dutch animals to be a bit narrower of chest than the American ones.

The width of the hips is given at 16.2 c.m. at birth and 51.1 c.m. at 30 months, whereas we find 17.5 c.m. and 50.5 c.m. There is a decided difference in proportions between the two sets of calves here, the American animals being wider in the chest at birth than they are over the hips, the Dutch animals showing the reverse.

The length of the body, though a very difficult measurement to determine accurately, is given at 60 c.m., being about 10 c.m. less than the height at the withers and increases to 158.1 c.m. The difference in our figures at birth is somewhat smaller, the body being 69 c.m. long and increasing to 155 c.m. in 30 months. The average Dutch Friesland appears to be slightly shorter when mature and slightly longer at birth than his American colleague.

The length of the rump is given at 21.5 c.m. at birth and increases to 46.4 at 30 months by the American animals, while the Dutch animals have a rump which is 23.5 c.m. long at birth and increases to 48.5 c.m. at 30 months old. The increase in rump is about the same in both sets of animals and the greater length of the American animals appears to be due to a longer midquarter rather than to a longer rump.

Interesting comparisons about the dimentions of the rump of American and Dutch Frieslands can be made from these figures, the American animals showing at birth a relation of 16.2 : 21.5 between the width of the hips and the length of the rump, the Dutch animals showing 17.5 : 23.5 at the same age,

which means that the rump of the Dutch animals is relatively narrower at the hips than that of the American animal. At $2\frac{1}{2}$ years of age the proportions are 51.1 : 46.4 for the American animals and 50.5 : 48.5 for the Dutch animal, which proves that at that time the Dutch animal possesses a rump, which is more square shaped and less broad over the hips in comparison to its length.

The rump of the American animals, according to these figures, seems to be slightly shorter and inclined to be a bit coarse at the hips in comparison with the rump of the Dutch animals, which is longer and and more square.

In a publication about the development of dairy heifers in connection with their feeding and age of calving Reed, Fitch and Cave (4) give some figures about measurements of certain parts of the body.

Selecting the group III out of their different groups as being the most normally fed one, calving also at a normal age, the height of the animals at the withers is 75.7 c.m. at birth and 129.2 when 30 months old, showing thus a slightly smaller growth than our animals.

The width of the hips is 17.2 c.m. at birth and 50.2 c.m. at 30 months old, which figures are practically the same as we have found in Dutch animals.

The width of pinbones increases from 7.5 c.m. at birth to 19 c.m. at 30 months old, while our animals show at birth a width of 5.5 c.m., increasing till the same age to 19.5 c.m.

(See for the figures of the measurements Tab. I.)

The Rate of Growth.

Every mathematically schooled investigator has to undergo the temptation to treat figures found about the growth of animals or about other physiological phenomena in a way enabling him to derive certain formula from them and is sometimes too eager to sacrifice certain irregularities in his series of figures for the sake of finding this formula.

Excepting the doctrine, that growth is a regular physiological function and that the decrease in growth during certain intervals is about the same, some investigators have gone so far as to arrive at formulae with the help of which it would be possible to calculate the size of the different parts of the body at any given age.

Irregularities found by these investigators are put down to small changes in feeding, surroundings, etc., and out of the broken curve obtained by plotting the actual figures, is constructed a smoothed curve for which a formula can be calculated.

Irrespective of the fact that certain factors as feeding, climate, etc., certainly influence the growth of the animals, it is quite possible that other internal factors in every animal itself do change the rate of growth during certain periods and that growth is not at all a gradually decreasing physiological process with a regular, constant decrease in a unit of time, but that growth in every animal takes place by leaps and bounds and that the increase in size of the parts of the body is in itself without any outward influence represented by a broken and not by a smooth curve.

Brody and Ragsdale, as mentioned above, assume that the decrease in growth of a certain part during a month expressed in percentages of the growth during the preceding month, is about constant, though the figures they publish do not show so great a constancy as they assume.

But even supposing that the inconsistency of the decrease in their investigations is largely due to influences of environment and feeding, the question at once arises if it is a sound principle to express the growth of a certain month in percentages of the growth of a preceding month.

The growth in the preceding month is acquired by the multiplication of a certain number of cells, while the growth in the following month is due to the multiplication of a greater number of cells because the newly-formed cells will begin to divide themselves too.

If an animal has at birth a height at the withers of 80 c.m. and is growing 15 c.m. the first month and again 15 c.m. the second month, it cannot be said that the growth has been the

same because during the first month the growth was 15/80 of the available material, while during the second month the growth decreased to 15/95 of the material. In the calculations mentioned above this is never taken into account, which in my opinion must be done even if one likes to find certain formulae for the decrease in growth during certain intervals. This is the reason that we have expressed the rates of growth in percentages of the measurements at the preceding period.

TABLE II.—RATES OF GROWTH IN PERCENTAGES OF THE MEASUREMENTS AT THE PRECEDING PERIOD.

Age of the Animals.	Height at withers.	Height at rump.	Length of body.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
From birth—											
¼ year ...	18·2	18·2	28·3	25·8	21·9	34·3	23·3	36·4	23·4	7·3	8·7
¼— ½ year	15·4	14·3	22	27·4	30·7	27·7	24·2	46·7	20·7	11·8	9 2
½— ¾ „	11·4	12	12·5	16·1	11·8	16·7	12·1	18·2	10	6·1	5·2
¾—1 „	2·2	2·1	4·5	4·7	1·7	8·6	4·1	11·5	5·2	2·9	4
1 —1¼ „	4·8	5	7·1	8·1	13·8	10·5	9·1	10·3	7·4	1·4	2·9
1¼—1½ „	2·1	1·6	3·6	5·8	9·1	7·1	4·8	9·4	3·4	1·4	1·9
1½—1¾ „	4·5	3·9	3·2	3·9	5·6	4·4	4·5	5·7	5·6	1·3	0·9
1¾—2 „	0·4	0·7	3·1	1·5	—	4·3	1·1	2·8	—	—	—
2 —2¼ „	—	10·7	1	0·8	11·3	—	1·1	2·7	—	—	—
2¼—2½ „	1·6	2·3	2·3	3	1·3	3·1	2·2	2·6	2·1	—	—

This table certainly reveals no definite decrease in the rate of growth, and any attempt to calculate a formula for every part of the body for its specific rate of growth has to be considered rather as treating a matter mathematically without giving due credit to undeniable irregularities.

It might, however, be possible to find a certain regularity by expressing the increase in size as percentage of the total increase made during growth or as percentage of the total size of the different parts at 2½ years of age.

In Table III the percentage-increases are given if the total increase from birth till 2½ years is taken as 100, and neither the figures of this table nor those of the preceding Table II reveal any regularity, which could lead to the calculation of certain formulae. (See page 23.)

It may be suggested, that the observed irregularities are entirely due to irregularities in feeding, climate, eventual weather conditions, etc., which forced the breeders to keep their animals indoors during certain times of the year and did not allow them to provide the animals with the same kind of feed all the year round.

Knowing how keen the Dutch breeder is to keep his animals growing and how careful he is watching his animals in this respect, one cannot escape the impression, that beyond the influences mentioned, which tend undoubtedly to irregularities in the development of the different parts of the body, other unknown influences must be at work to counteract even the great care the breeders of Friesland animals in Holland take to secure a regular growth. Figures we are busy to collect about the growth of Friesland animals in South Africa may perhaps throw more light on this question and may give indications to what extent these unknown influences are responsible for the observed facts.

Table II and Table III give interesting figures about the speed of growth during certain ages and about the difference in speed of growth between different parts of the body.

In connection with the rates of growth (see Table II) the width between the hips and the width between the pinbones show an enormous rate during the first quarter of a year after birth, whereas the rate of growth of the legs is very small. From the other parts of the body, the length of the body shows a high rate of growth, the depth and the width of the chest, the width of the rump measured at the thurl and the length of the rump having a slightly smaller growth, while the height of the animal measured at the withers and at the beginning of the rump increases slower.

During the period between $\frac{1}{4}$ and $\frac{1}{2}$ year old some peculiarities in the rate of growth can be noted as the higher rate of growth compared with the preceding period of the depth and width of the chest and of the width between the pinbones, whereas a decrease in rate is to be seen in the other parts of the body except the width of the thurl, which does not show a very marked difference in rate between the two periods mentioned.

Another striking difference exists between the rate of growth of the height at the withers and that of the height at the rump, the former showing a somewhat greater rate, which reflects itself at the same time in the greater rate the front legs show in comparison with the hind legs.

This greater rate means, that the animal at the age between $\frac{1}{4}$ and $\frac{1}{2}$ year is growing more quickly in front than at the rear.

In the following period a marked decrease in rate of growth takes place in nearly all parts of the body, especially in the width of the chest and the width between the pinbones, and though the width between the hips, the width between the pinbones and the depth of the chest are still increasing rapidly, the figures show nevertheless a strong decline in growth.

The rate of growth of all the other parts has come down to practically the same level except that of the legs, which is still a good deal smaller.

The length of the body does not show any more the marked greater rate of growth than the height of the animal as was the case in both the preceding periods, and it appears therefore that in the earliest times of growth, during the first half year, the lack of length of the body of the calf compared with that of the mature cow is for the greatest part removed.

The width of chest is marked by a strong decline in growth which can perhaps be explained by the fact, that several animals were already kept in the stable when they were $\frac{3}{4}$ years old.

The period between $\frac{3}{4}$ years and 1 year, when all the animals were kept in the stable, is characterised by a strong decline in the rate of growth of almost every part of the body.

Especially the development of the chest appears to be affected seriously, while the least effect from this influence is shown by the width of the pinbones, the length of the rump and the growth of the legs. The width between the hips, the width of the thurl and the length of the body are less affected than the height of the body and the development of the chest.

Between 1 and $1\frac{1}{4}$ years, when all the animals are in the meadow again, the rate of growth appears to be greater for almost every part of the body except for the legs and the width between

the pinbones, which parts are growing less quickly than in the previous period. Especially the width of the chest is increasing rapidly, but all the other parts too show a rate of growth which is about 70—100% bigger than that in the previous period, with the exception of the length of rump and the width between the hips, the increases in rate of growth of which do not show such enormous differences as compared with the figures of the preceding interval.

It gives the impression as if the growth of the animals is for the greatest part stopped when they are kept in the stables and is made up again as soon as favourable influences (young green grass, sunshine, movement, fresh air, etc.) stimulate the cells of the body to greater activity.

After this is done the growth between $1\frac{1}{4}$—$1\frac{1}{2}$ years proceeds again more slowly, the height of the animal making but little progress, while the length of the body, the width between the hips, the width between the pinbones and the length of the rump continue to increase considerably however not at the rate of the period between $\frac{3}{4}$ and 1 year.

The depth and width of the chest at the contrary show even a greater rate of growth than in the period between $\frac{3}{4}$ and 1 year and the width of thurl too shows a slight increase in this respect.

The animal grows broader and deeper in parts, which are looked upon as being of great value for its constitution.

The chest is enlarging considerably, enabling the lungs and the heart to develop strongly and the pelvis is enlarging, which gives the sexual organs room to extend.

It is interesting to note how the width of the pelvic arch, demonstrated by the width of the thurl, is increasing just in the time that the sexual organs enter into the condition to carry the first foetus.

Between $1\frac{1}{2}$ and $1\frac{3}{4}$ years certain other changes in the rates of growth take place, which may be attributed to the fact, that a number of the animals were already kept in the stable, but which nature makes it more probable that the growth of some parts is stimulated by the beginning of pregnancy, the animals being nearly all served at this time of life.

The height of the animals in the period between $\frac{3}{4}$ and 1 year, when the animals are also kept in the stable, showed a comparatively small rate of growth, while in the period now under discussion the contrary is witnessed and the height of the animal has a greater rate of growth than in the previous interval. The entrance of pregnancy is perhaps the cause of this phenomenon, as it may at the same time be the cause of the extraordinary rate of growth of the width of the thurl and of the lentgh of the rump as compared with the rate of growth of the width over the hips and the width between the pinbones. The rate of growth of the width between the hips falls from about 7% to 4.5%, while that of the width between the pinbones falls from about 9.5% to 5.5%. The width over the thurl shows practically no fall in rate of growth and the length of the rump shows an increase in rate from about 3.5% to 5.5%.

The length of the body having in all periods a greater rate of growth than the height, is in this period growing less and its increase appears to be almost entirely due to the increase in the length of the rump.

In the following period, the period between $1\frac{3}{4}$ and 2 years, in which the animals were all kept in the stable, the height is increasing but slowly as all other parts of the body are, except the length and the width between the hips, which parts show practically no decline in rate of growth as compared with the preceding period.

It gives the impression that the animal uses more and more his surplus of feed, which would enable it to grow, for the development of the foetus and is only growing in the parts, which are not yet developed to such an extent, that they are in proportion to the other parts of the body. The body is still a bit short compared with the body of a mature cow, or at least a cow, who is ready to calve and the hips are not yet wide enough. The chest, though increasing still a little in depth, has ceased growing wider and only the width over the pinbones is increasing gradually to give a wider passage to the calf.

At the age between 2 and $2\frac{1}{4}$ years the majority of animals brought their first calves and the necessity of converting all the surplus nutrient in available material for the growth and main-

tenance of the foetus appears to be the cause of a stagnation in growth as proved by the rates of growth, which are practically all nil and are even for some parts of the body negative, which may be caused by a loss of condition of the animal during the first months of its milk production.

Only the length, the width of thurl and the width between the pinbones illustrate that some growth has still taken place.

In the last period the animals show that their growth was only held up by the process of pregnancy and parturation, as the rate of growth between $2\frac{1}{4}$ and $2\frac{1}{2}$ years is for every part of the body considerably greater than in the preceding interval except for the legs, which have ceased developing after the age of $1\frac{3}{4}$ years. But even the length of the rump, showing no increase in two previous periods, is increasing again as is the thurl and the width between the pinbones. The last measurement shows during the entire growth the most regular decrease in rate.

The hips start developing again, the chest grows wider and deeper, partly on account of the better condition the animals generally showed, but partly too on account of real growth, the animal increases in height, etc.

The greater increase in height at the rump is probably due to the straightening of the loins after calving as the decrease in height of this part in the last months of pregnancy may be caused by the sinking of the loins and the straightening of the rump whereby the connection between the loins and the rump will be lowered.

The figures in Table III confirm the facts mentioned in discussing the rates of growth as given in Table II and give at the same time some illustration about the growth in the different periods as compared with the total growth between birth and $2\frac{1}{2}$ years of age.

Noteworthy is here the tremendous increase in size of the different parts during the first half year in which the height and the length of the animals increase about 50% of the total increase till $2\frac{1}{2}$ years. Some other parts as the depth of the chest, the length of the rump and the width of the thurl show the same increase, while the width between the pinbones and the width

between the hips do not show so great an increase and the legs on the contrary show even greater increase. These facts must cause the proportions of the body to alter considerably during this time of life of the animal.

TABLE III.—DIFFERENCES IN MEASUREMENTS OF BODY, IF TOTAL DIFFERENCE BETWEEN BIRTH AND $2\frac{1}{2}$ YEARS = 100.

Age of the Animals.	Height at withers.	Height at rump.	Length of body.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
At birth	—	—	—	—	—	—	—	—	—	—	—
$\frac{1}{4}$ year	24	24	23	18	16	18	19	14	22	20	23
$\frac{1}{2}$ „	24	22	23	25	27	19	24	25	24	35	27
$\frac{3}{4}$ „	20	22	16	16	14	15	15	14	14	20	17
1 „	4	4	6	6	2	9	6	10·5	8	10	13
$1\frac{1}{4}$ „	10	10	10	11	18	12	13	10·5	12	5	10
$1\frac{1}{2}$ „	4	3	6	9	14	9	8	10·5	6	5	6·5
$1\frac{3}{4}$ „	10	9	5	6	9	6	8	3·5	10	5	3·5
2 „	1	2	5	3	—	6	2	3·5	—	—	—
$2\frac{1}{4}$ „	—	–2	2	1	–2	—	2	3·5	—	—	—
$2\frac{1}{2}$ „	3	5	4	5	2	5	4	3·5	4	—	—
Total %	100	99	100	100	100	99	101	98·5	100	100	100
Total in c.m.	57	58	86	40·5	22	33	26·5	14	25	10	15

Striking too is the small increase in size of nearly all parts of the animals during the period from $\frac{3}{4}$—1 year old, which may be due to the stabling. However this explanation cannot serve to explain the small increase in growth during the period of $1\frac{1}{4}$—$1\frac{1}{2}$ years as most of the animals were at the time running in the meadow.

We feel more inclined to accept this small increase as the normal increase during this period and to explain the greater increase during the following period as a stimulation in the growth caused by the fecundation and the beginning of pregnancy, which take place during this period.

Figures collected by measuring animals under more uniform conditions during growth than prevail in Holland can perhaps throw more light on this irregularity in growth.

The Change in Proportions of the Different Parts of the Animal.

In order to illustrate the changes the different parts of the body undergo in proportion to each other, the measurements of these different parts have been expressed in percentages of the length of the body and in percentages of the height at the withers, thus making it possible to compare the size of every part with the total length and with the total height of the body. It was considered better to use these two standard measurements instead of one of them, as the constant change these measurements are also undergoing themselves might lead to false impressions about the change in proportions, if only one of these measurements was used as standard comparison.

TABLE IV.—LENGTH OF BODY = 100.

Percentage of :—

Age of the Animals.		Height at withers.	Height at rump.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
At birth		107	111	41	22	25	30	8	33·5	38	55·5
¼ year		100	104	41	21·5	26	30	8·5	33	34	50
½ „		93	97	42·5	23·5	27·5	30·5	10	32	30	43·5
¾ „		92	95·5	43·5	23	29	30·5	10·5	31	29	41·5
1 „		90·5	94	44	23·5	30	30·5	11·5	32	28·5	41
1¼ „		88·5	92	44·5	24·5	31	31	12	32	27	39·5
1½ „		87·5	90·5	45	26	32	31	12	31·5	26	38·5
1¾ „		88	90·5	45·5	26	32·5	31	12	32	25·5	38
2 „		86	89	44·5	25	32·5	31	12·5	31·5	25	37
2¼ „		85·5	87·5	44·5	24·5	32·5	31	12·5	31	24·5	36·5
2½ „		85	87·5	45	24·5	33	31	12·5	31·5	24·5	36

The Changes in regard to the Length of Body.

(See Table IV and Fig. IV, V and VI.)

The height at the withers and the height at the rump. (Fig. IV.) Both measurements are bigger than 100% when the animal is born and we can therefore say that every calf is at birth taller than long. Soon, however, at the age of about $\frac{1}{4}$ year the length and the height of the body are alike and the decrease in height expressed in percentages of the length is very rapid during the first half year, whereafter it becomes more slow until the age of $1\frac{1}{2}$ years.

At this age the body appears to increase a little quicker in height than in length, which can be noted by the ascending line between the age of $1\frac{1}{2}$ and of $1\frac{3}{4}$ years, whereafter a gradual descent in the line for the height at the withers denotes again a gradual small decrease. The height at the rump does nowhere show increase but remains only the same in the period between $1\frac{1}{2}$ and $1\frac{3}{4}$ years, after which it continues to grow smaller till at $2\frac{1}{4}$ years it has reached the lowest point and remains from there till $2\frac{1}{2}$ years the same, while in this period the height at the withers continues to decline. The sinking of the loins and the straightening of the rump is possibly the cause of the greater decrease of the height at the rump as compared with that at the withers in the period between 2 and $2\frac{1}{4}$ yars.

The depth of the chest. (Fig. V.) The chest is increasing in size compared with the length during the first $1\frac{3}{4}$ years except during the three months just after birth, wherein the increase in length and the increase in depth of chest are just proportional to their respective sizes at birth.

FIG. IV.—DECREASE DURING GROWTH IF LENGTH OF BODY IS TAKEN AS 100.

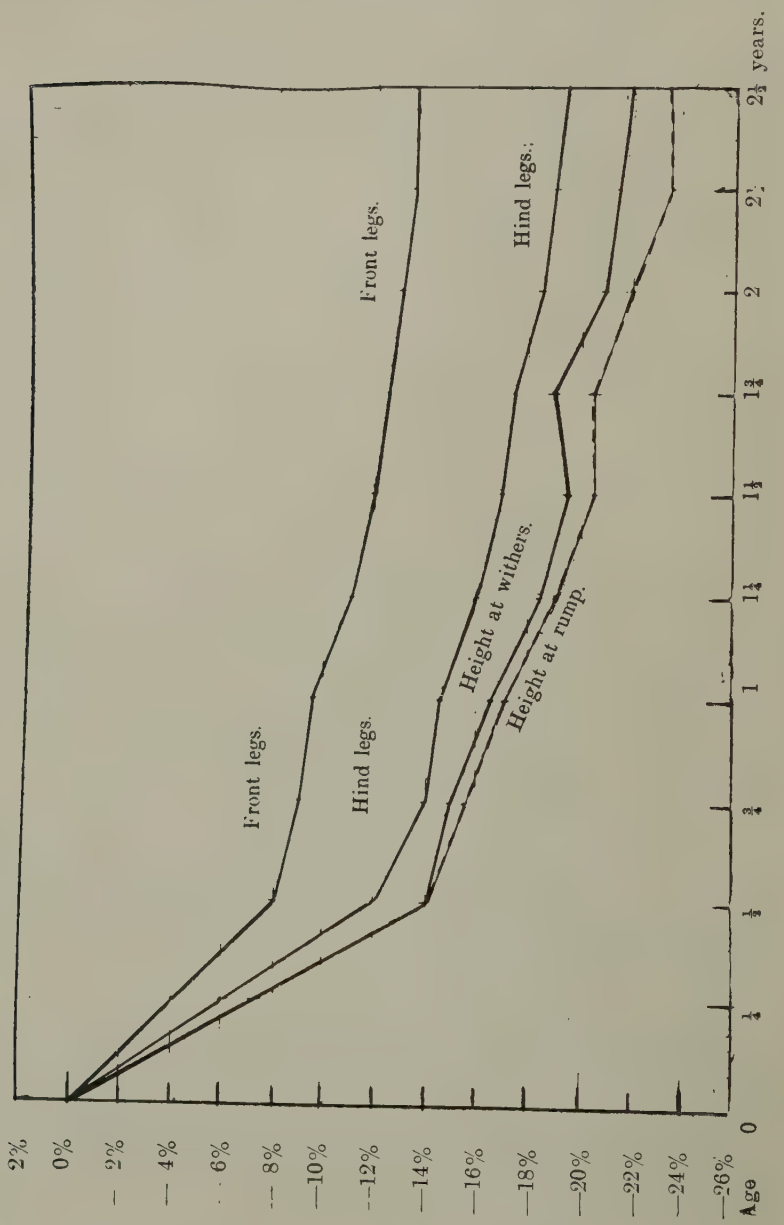
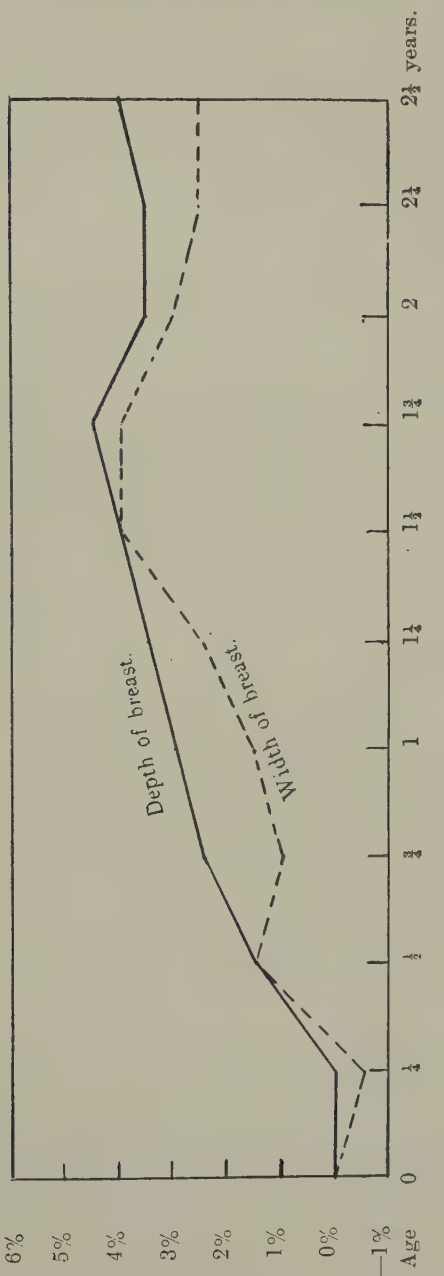


FIG. V.—INCREASE DURING GROWTH IF LENGTH OF BODY IS TAKEN AS 100.



The increase in percentages is gradual with a tendency to be a little greater during the time when the animal is from $\frac{1}{4}$ till $\frac{3}{4}$ years old and to remain constant till the animal is $1\frac{3}{4}$ years.

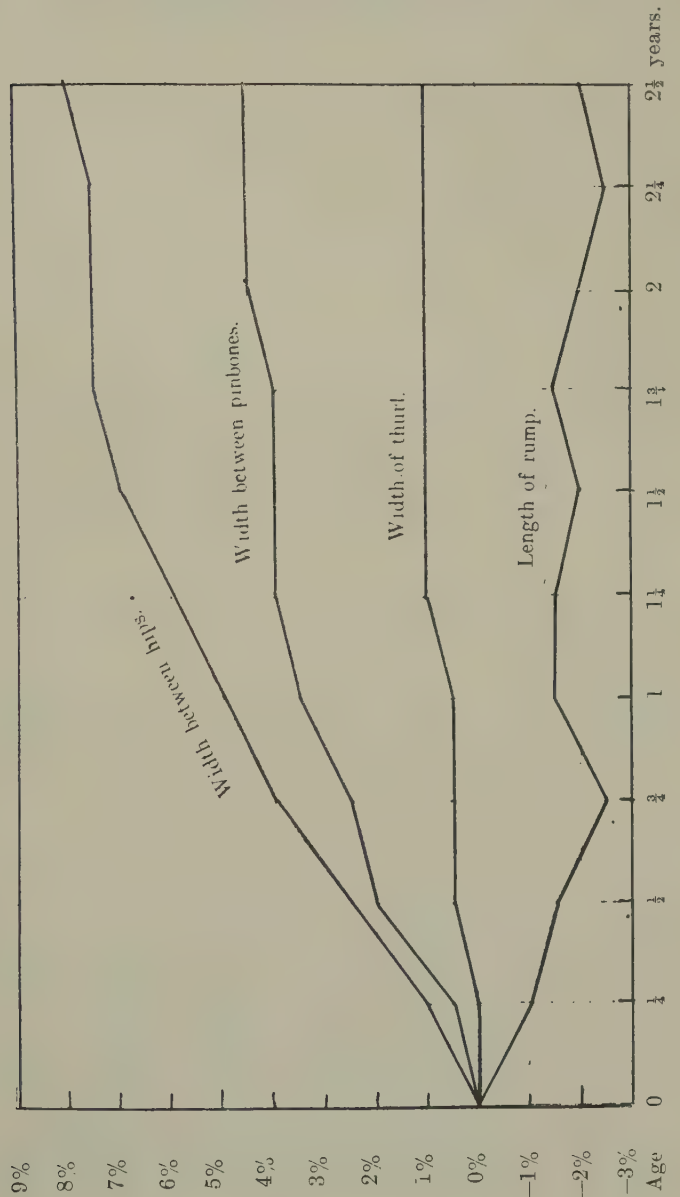
After that time the chest is not growing in depth as fast as the body is increasing in length and the line representing the proportion between the two measurements dclines till after calving a slight ascent is noted again.

The width of the chest. (Fig. V.) During the first three months of the life of the calf, the width of its chest is not increasing proportionally as quickly as the length of its body. This period is followed by a period of three months, wherein the calf is kept in the meadow and shows a quick increase in width of chest, followed again by a period of three months in which the length of the body is increasing more in proportion than the width of the chest. After the age of $\frac{3}{4}$ years a steady increase in the development of the chest takes place, followed by a period between $1\frac{1}{2}$ and $1\frac{3}{4}$ years, in which the increase is temporarily arrested. Between the last age and the age of $2\frac{1}{4}$ years the width of the chest increases more slowly than the length of the body perhaps on account of proceeding pregnancy and falling of in condition of the animal. After having calved the growth of the chest goes on proportional to that of the length of the body.

The measurement of the rump. (Fig. VI.) All proportions of the rump show approximately the same course of growth except the length.

The width between the hips increases most of all and shows a quick increase till the animal is $1\frac{3}{4}$ years old, after which age it remains the same in proportion to the length of the body and only increases again a little after the animals have calved.

FIG. VI.—INCREASE OR DECREASE DURING GROWTH IF LENGTH OF BODY IS TAKEN AS 100.



The width between the pinbones shows a smaller increase and stops at the age of $1\frac{1}{4}$ years old to show a second period of increase between $1\frac{3}{4}$ and 2 years.

The width of the thurl develops fairly proportional to the length of the body with a small increase up to the age of $1\frac{1}{4}$ years.

The line representing the proportion of the length of the rump to the length of the body illustrates quite a different development. The longest rump in proportion to the entire length of the body is found at birth and from that moment the rump does not grow as quickly as the length of the body and decreases proportionally. The decrease is, however, not of a regular character, but is very irregular and periods, wherein the rump grows more quickly in length than the body does, change with periods in which the body seems to acquire more length than the rump does in proportion.

A definite period of decrease can be noticed between birth and $\frac{3}{4}$ years, followed by a long period till $1\frac{3}{4}$ years in which there is a tendency of the rump to grow more quickly, and this period is again followed by one in which the animal certainly thanks its growth in length more to the elongation of other parts of the body than to that of the rump. After calving the rump shows again a small increase in length.

As the measuring of the length of the rump is quite simple and is not bound to cause much difficulty or many errors, the difference in the development in this direction as compared with the growth of the rump in width, must have some reason. The decrease in length just at the time that the young calf begins to consume a fair amount of roughage, which consumption may cause his intestines and thus his midquarter to develop more than the other parts constituting the length of the body, may be the reason for the falling off in length of rump expressed in percentages of the length of the body.

The decline in the period between $1\frac{3}{4}$ and $2\frac{1}{4}$ years coincides with the period of pregnancy, in which the midquarter may get a second stimulus for a greater proportional development than the hindquarter shows.

Surely there is no proof of the truth of this explanation, and we present it only as a probability, which existence has to be illustrated by a great number of figures collected from growing animals under different circumstances.

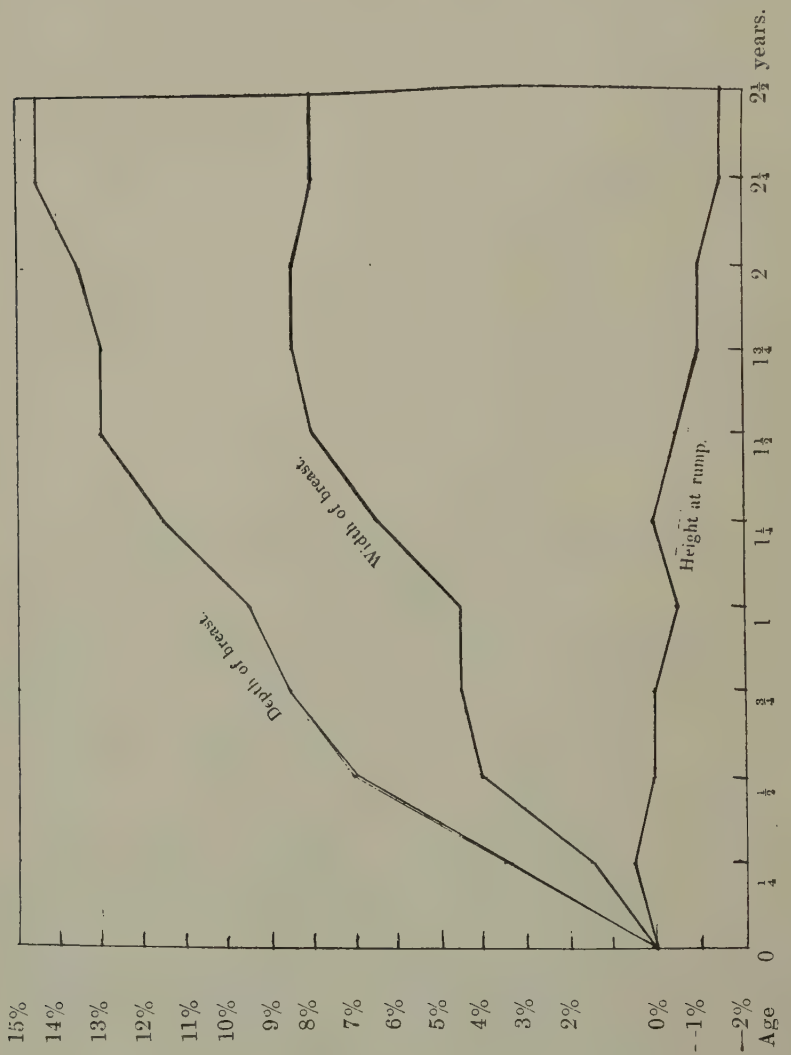
The legs. (Fig. IV.) These parts of the animal are longest in proportion to the length of the body when the animal is born and decrease gradually in relative length when the animal grows older. The decrease is in total very considerable, which fact illustrates very clearly the great length of the legs of every young animal compared with a mature animal.

TABLE V.—HEIGHT AT WITHERS = 100.

Percentage of:—

Age of the Animals.	Length of body.	Height at rump.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
At birth	93·5	104	38·5	21	23·5	28·5	7·5	31·5	35·5	52
¼ year	100	104·5	42	22·5	26·5	30	8·5	33	34	50
½ „	106·5	104	45·5	25	29·5	33	10·5	34·5	32·5	47
¾ „	108	104	47	25·5	31·5	33	11·5	34·5	31·5	44·5
1 „	110	103·5	48	25·5	32·5	33·5	12·5	35	31·5	45
1¼ „	113	104	50	27·5	35	35	13·5	36	30·5	44·5
1½ „	114·5	103·5	51·5	29	36·5	35·5	14	36·5	30	44
1¾ „	113	103	51·5	29·5	37	36	14	36·5	29	42·5
2 „	116	103	52	29·5	38	36·5	14·5	37	29	43
2¼ „	117	102·5	53	29	38	36·5	14·5	37	29	43
2½ „	117·5	102·5	53	29	38·5	36·5	15	37	28·5	42

FIG. VII.—INCREASE DURING GROWTH IF HEIGHT AT WITHERS IS TAKEN AS 100.



The Changes in regard to the Height at the Withers.

(See Table V and Fig. VII, VIII, IX and X.)

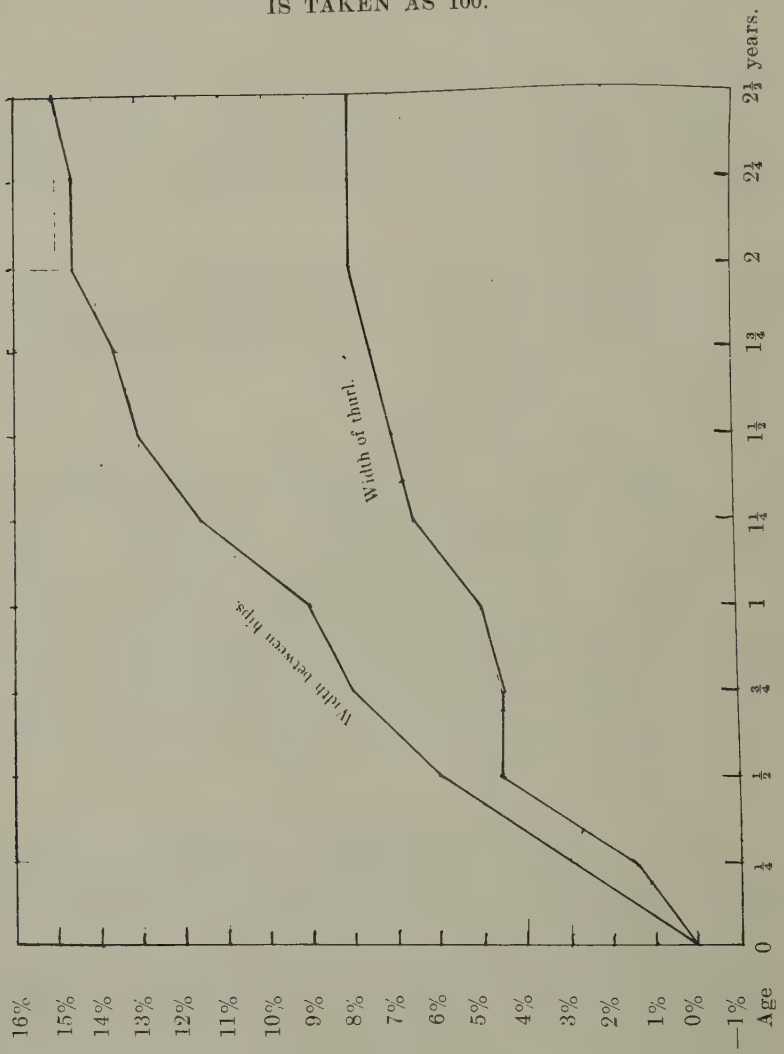
The height at the rump. (Fig. VII.) In comparison with the height at the withers, the height at the rump is slowly decreasing, though not much, during the growth of the animal, which means that the calf is proportionally lower in front than the mature animal.

Brody and Ragsdale find in their investigations in the growth of Holstein-Friesians in America a decrease from 105.5% to 101.7% at the age of $2\frac{1}{2}$ years, whereas the figures collected from Dutch animals show a decrease from 104% to 102.5%.

The depth of chest. (Fig. VII.) The depth increases from 38.5% at birth to 53% at the age of $2\frac{1}{2}$ years as compared with the figures Brody and Ragsdale give of 39.7% to about 52%. This part of the body shows a very rapid development from the day the animal is born till it has reached the age of $1\frac{1}{2}$ years, after which age the increase goes on more slowly. The curve representing the change in proportions shows a fairly regular shape with a slight inclination towards a little quicker growth during the periods between birth and $\frac{1}{2}$ year and those between 1 and $1\frac{1}{2}$ years, perhaps due to he influence of the stay in the meadow during these times.

The width of chest. (Fig. VII.) The curve representing the increase in width of the chest in proportion to the height of the animal, is marked by two distinct irregularities. During the above-mentioned periods in which the depth of the chest was growing a little quicker, the growth in width of the chest is considerably more than during the other periods and the curve confirms the impression got from the discussions about the rates of growth, that these two periods are highly responsible for the development of the width of the chest and coincide with the periods in which the animals are kept in the meadow.

FIG. VIII.—INCREASE DURING GROWTH IF HEIGHT AT WITHERS IS TAKEN AS 100.



Between ½ and 1 year and between 1½ and 2 years old the animals are generally kept in the stable and the growth in width of the chest in proportion to the height of the animal is about nil, which means that the animals are relatively not growing any broader. In the last period of pregnancy the width falls a little.

The total increase in width in the Dutch animals is from 21% to 29%, while the figures for the Holstein-Friesian, collected by Brody and Ragsdale, give proportions from 24% at birth till 31.5% at 2½ years.

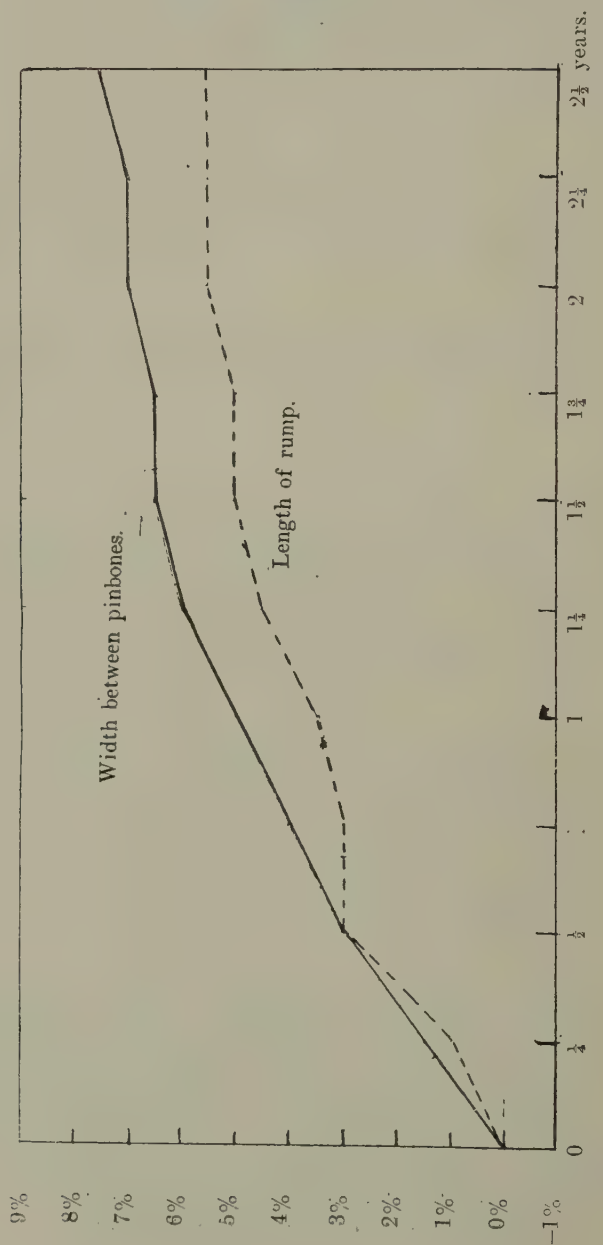
Compared with the American animals at 2½ years of age, the Dutch animals are thus a little deeper and a little narrower in the chest.

Width between the hips. (Fig. VIII.) There is a tremendous increase in this quality compared with the height of the body and from all parts of the rump the width between the hips makes the greatest progress changing its proportion during the growth from 23.5% to 38.5%. The same can be noted in the figures Brody and Ragsdale give about this quality, which changes in their animals for the same time from 23% to 38%.

The growth of this part is very gradual and the line representing the percentages runs gradually upwards with a slight convexity indicating that the growth in the earlier periods is a little quicker than that in the later periods of life. The sharp rise occurring in the graphs of Brody and Ragsdale which these authors ascribe to the period of gestation cannot be noted in the graph representing the figures of the Dutch animals.

The width of thurl. (Fig. VIII.) The increase in this proportion is much less than in the proportion of the hips and shows a less regular course. During the first half year a rapid change in proportion can be noted, while during the following half year the width at the thurl is not increasing considerably. Then follows a regular increase till the last three months of pregnancy, in which the height of the animal and the increase in width of its thurl keep relatively pace together.

FIG. IX.—INCREASE DURING GROWTH IF HEIGHT AT WITHERS IS TAKEN AS 100.



The reason for the suddenly slower increase between ½ and 1 year may be caused by the stay in the stable during this time, but this same stay did not have any marked influence at the time the animals were between 1½ and 2 years old.

It may be too, that the first signs of heat, which develop in the Frieslands often at an age between 6 and 8 months, have a retarding influence on the development of the thurl, but without further material it cannot be decided, which of these reasons is the cause of the well-marked irregularity in the development of this part of the body.

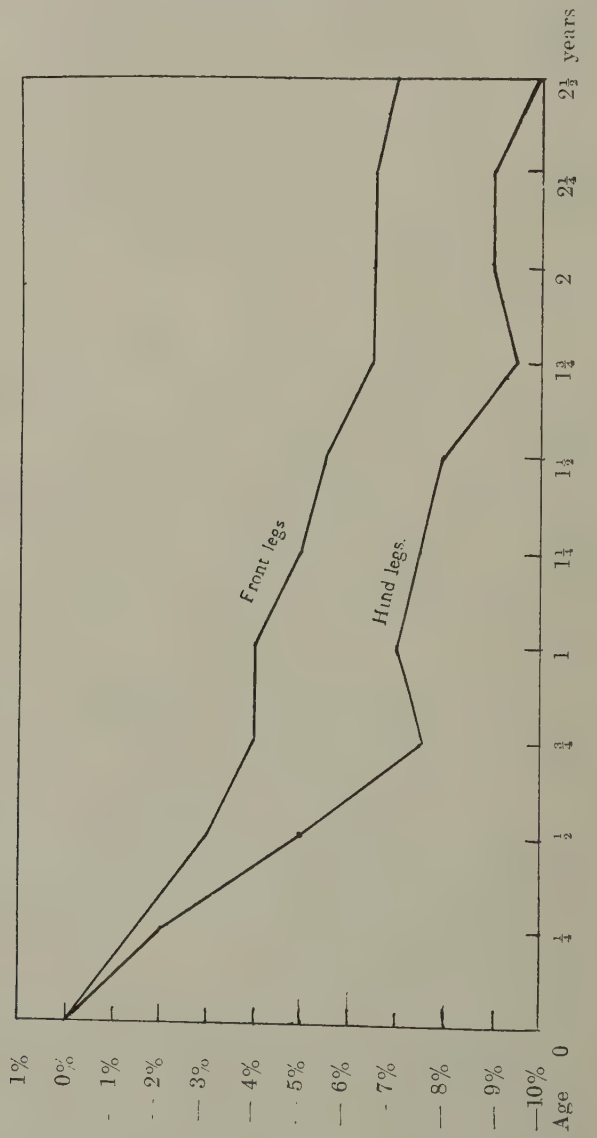
Width between the pinbones. (Fig. IX.) This quality is developing very regularly in proportion to the height and the graph representing the increase at different ages, runs fairly straight upwards with a slight tendency to convexity, indicating again that the relative progress in width is a little greater during the earlier parts of life than it is later on.

Irregularities of a distinct nature are absent.

Length of rump. (Fig. IX.) In proportion to the height of the animal this part develops most slowly of all the parts of the rump, and the course of the graph outlining this development resembles strongly the course of the graph of the width of the thurl and shows the same peculiar dip between ½ and 1 year. Between 1½ and 2 years a slight inclination to a second dip is noticeable however, so slight that its significance can be attributed too to the unavoidable experimental errors always existing where groups of animals are concerned.

The total increase in proportion to the height of the withers is from 31.5% at birth to 37% at 2½ years in the Dutch animals, while Brody and Ragsdale find for the American animals 30.5% at birth and 35.6% at 2½ years, which proves that the Dutch animals are slightly longer in rump than the American ones.

FIG. X.—DECREASE DURING GROWTH IF HEIGHT AT WITHERS IS TAKEN AS 100.



The legs. (Fig. X.) The length of front legs steadily decreases in comparison to the height at the withers and so does that of the hind legs; however the latter shows at certain periods of life exceptions of this rule, which are of interest. Generally the length of the legs decreases proportionally more strongly during the first nine months after birth and the animal thus becomes quickly deeper during this time.

TABLE VI.—PRECENTAGES OF SIZE OF THE PARTS OF THE BODY IF MEASUREMENTS AT 2½ YEARS OF AGE = 100%.

Age of the Animals.	Height at withers.	Height at rump.	Length of body.	Depth of chest.	Width of chest.	Width between hips.	Width of thurl.	Width between pinbones.	Length of rump.	Distance front knee to ground.	Distance hock to ground.
Atbirth	56·5	57	44·5	42	42	34·5	45	28	48·5	73·5	72·5
¼ year	67	67	57	52·5	51	46·5	55	38·5	60	78·5	7 9
½ „	77	77	70	67	67	59·5	68·5	56	72	89	86·5
¾ „	86	86	78	76	75	69	76·5	66·5	79·5	93·5	91
1 „	88	88	82	79·5	76	75	80	74·5	83·5	96	94·5
1¼ „	92	93	88	86	87	83	87·5	82	89·5	97·5	97·5
1½ „	94	94	91	91	95	89	91·5	89·5	93	99	99
1¾ „	98	98	94	95	100	93	96	92·5	98	100	100
2 „	98·5	98·5	97	96·5	100	97	97	95	98	100	100
2¼ „	98·6	98	98	97	99	97	98	97·5	98	100	100
2½ „	100	100	100	100	100	100	100	100	100	100	100
Total in c.m.	131	135	155	69·5	38	50·5	48	19·5	48·5	37·5	55

Suddenly during the time when the animal is nine months up till a year old, the growth in length of the front legs keeps relatively pace with the growth in height of the animal, while the hind legs even develop a little more quickly. After the animal has reached the age of 1 year the growth in length of the legs is again smaller than the growth in height of the animal, till at the

age of $1\frac{3}{4}$ years again a period can be noted till the animal calves, wherein the front legs grow proportional to the height of the animal and the hind legs grow even a bit faster. It may be sheer coincidence that both periods, in which the legs show proportionally the same of even more increase than the height of the animal, are the last three months of the half-yearly stabling of the young animals in Holland, which would induce one to think that the lack of movement is either retarding the increase in size of the animal or is stimulating the growth of the legs.

Researches planned with animals kept outdoors during the whole time of their life (which is quite probably on account of the climatic conditions in the south-west of South Africa) will show if this coincidence is merely accidental or is due to definite influences exercised by the lack of movement and of fresh air.

The Development of the parts of the Body before and after Birth of the Animal.

(See Tab. VI and Fig. XI.)

Taking the size of the parts concerned as 100 at the age of $2\frac{1}{2}$ years, the size of the parts in the different periods can be expressed in percentages of this measurement and a clear conception can be got of the development of these parts during intrauterine life and during extrauterine life.

The table as well as the figure clearly show that the greatest development after birth occurs in the width between the pinbones, which is at birth less than one-third of the total width at $2\frac{1}{2}$ years old.

A little over a third of the total development is noted for the width between the hips at birth.

The chest at birth has about 40% development of the chest at $2\frac{1}{2}$ years old, the length of the body and the width of the thurl are 45% at birth, the length of the rump develops even still a little less during extrauterine life, being at birth already 48% of the entire length at $2\frac{1}{2}$ years.

The height of the animal is at birth about 55% from the height at 2½ years and the legs are at that time more than seven-tenths of their final size at 2½ years.

Comparing these figures with those of Brody and Ragsdale, these investigators find the width of hips to be about 29% at birth, the width of the chest about 36%, the depth of the chest about 41%, the length of the rump about 44%, the height at the withers about 54%, the height at the rump about 56%, the legs (determined by substracting depth of chest from height at withers) about 68%.

Because their figures are calculated with the size of the different parts taken as 100 at the age of 5 years, their figures are generally a little lower than ours, the order in which the parts rank in regard to their original size at birth being however the same as ours.

If the change in the height of the animal is taken as 100, the changes of the other parts as given in Table V are calculated to be relatively :

Length of body 126%, Height at rump 99%, Depth of chest 138%, Width of chest 138%, Width between hips 164%, Width of thurl 128%, Width between pinbones 200%, Length of rump 114%, Distance from front knee to ground 80%, Distance hock to ground 81%.

These figures may be taken as a summary of the relative changes in form of the growing dairy animal up to 2½ years from the day the animal is born.

They reveal the enormous differences existing in proportion between the calf and the cow, differences which are of great practical value because they enable us to better judgment of the exterior of the young growing dairy animal.

Stellenbosch, October, 1927.

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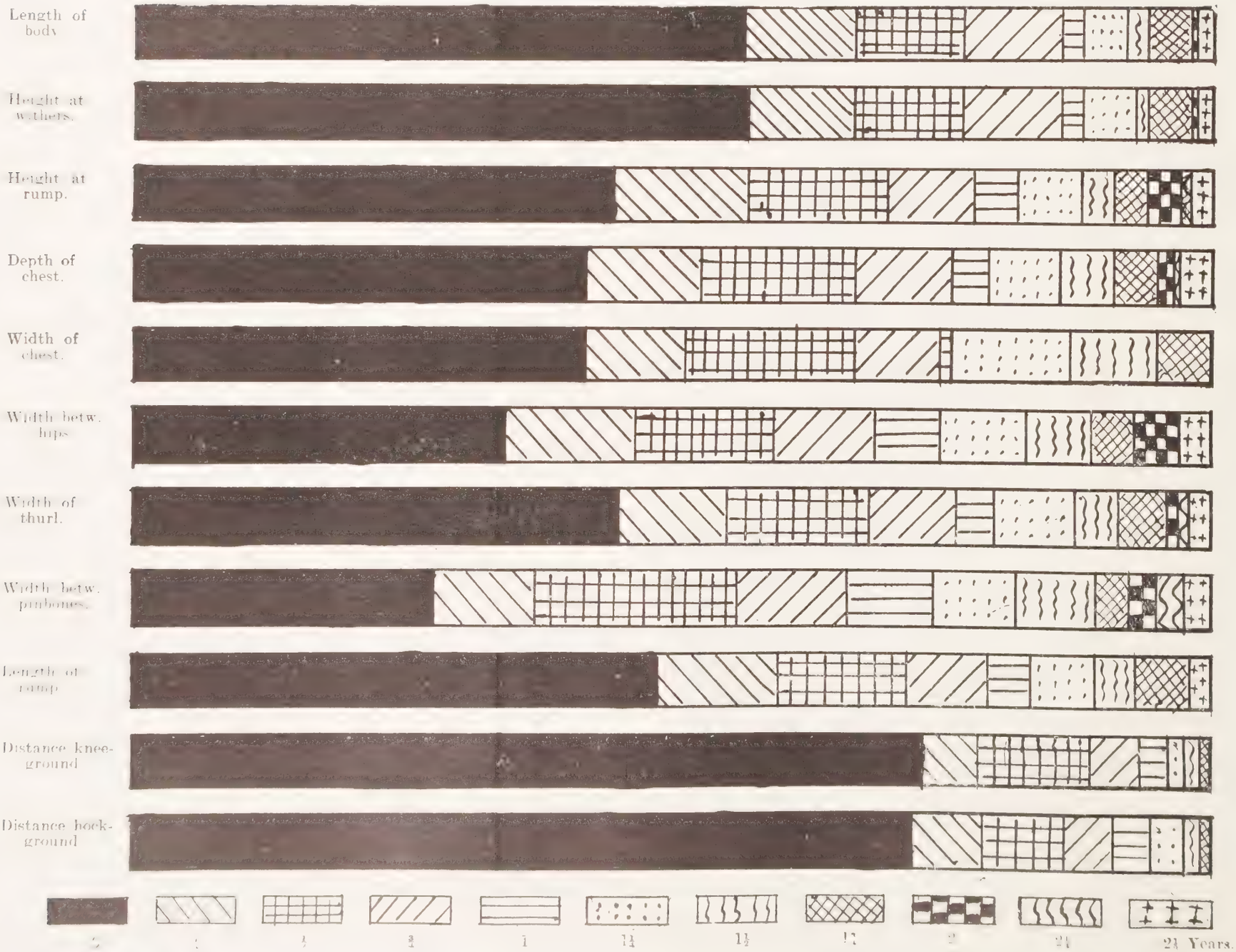
FIG. XI.—PERCENTAGE INCREASE IN THE SIZE OF THE DIFFERENT PARTS IF THE SIZE AT 2½ YEARS IS TAKEN AS 100.



CONTRIBUTION TO OUR KNOWLEDGE OF THE STELLENBOSCH FLORA.

CONTRIBUTION TO OUR KNOWLEDGE OF THE STELLENBOSCH FLORA.

THE SPECIES OF URGINEA OF THE STELLENBOSCH FLATS.

Of the sixty-six native species of the family Liliaceae which occur on the Stellenbosch Flats ten have proved to be new to science and several others may be classed as rarities. Among the latter is *Urginea Eckloni,* Baker, originally collected by Ecklon and Zeyher, and hitherto known only from the incomplete type specimens in the Berlin Herbarium and from Baker's published descriptions. Five of the new species are described in the present paper. Two belong without any reasonable doubt to the genus *Urginea;* the remaining three possess a perianth which is united into a brief tube at the base, but in other respects they conform so closely to the recognised characters of Urginea that they have been provisionally assigned to the genus. In this connection it may be noted that *U. Dregei,* Baker, which occurs on the Stellenbosch Flats, has a short perianth tube, though this was not observed by Baker in his examination of the type specimens. Again of the two closely related species *U. pygmaea* and *U. minor* described in the present paper, the former has a short but clearly defined tube, while in the latter the tube is almost obsolete. It would appear that the presence or absence of a perianth tube may not always be of deciding value, and in the light of a more critical study of our South African material the characters of such genera as *Urginea* and *Drimia* may require to be extended or modified. A revision of these and other allied genera, if it is to be of permanent value, must be based on the study of the living plants wherever possible.

Six of the local species of *Urginea* occur in well-drained sandy or gravelly soil, the remaining three inhabit somewhat clayey areas in which the soil tends to become water-logged in the winter and excessively dry and compacted during the summer months. All have slender terete or sub-terete leaves. *U. Dregei*, described by Baker as having a linear leaf, is no exception, for the co-type in the Bolus Herbarium shows a cylindrical leaf which has been flattened in drying. *U. Dregei*, *U. gracilis*, *U. minor* and *U. pygmaea* flower during the first four months of the year and are usually hysteranthous.. *U. Eckloni*, *U. exuviata*, *U. filifolia* and *U. unifolia*, on the other hand, flower during September and October and are synanthous. As will be seen from Plate V, *U. Eckloni* and *U. unifolia* agree in possessing two-ranked bulb scales and a single leaf with a narrow, conspicuously bared basal sheath; but the capitate inflorescence of the former is totally unlike the elongated raceme of the latter.

The only species which appears to be liable to fungus infection is *U. exuviata*, the leaves of which sometimes show pustules of *Uromyces*. The fungus, which is a new one, was submitted to Dr. P. A. van der Byl, who has described it as follows :—

Uromyces stellenbossiensis, n. sp. P. A. v. d. Byl. Teleutosori amphigenous, scattered, dark purple brown, in greenish-yellow spots and each teleutosorus hence surrounded by a greenish-yellow border, elliptical, 1—4 mm. long, up to 1 mm. across, long covered by the epidermis; teleutospores brown, 28—42 x 18—28μ, subglobose, ovate or oblong, apex rounded or truncate; epispore uniformly thin (2μ); pedicels hyaline, 6—8μ diam., at times broadened immediately below the spore, tapering to the base, often deciduous.

On leaves of *Urginea exuviata* at Stellenbosch (2479). Collected by Miss A. V. Duthie. October, 1927.

Key to Species of Urginea which occur on the Stellenbosch Flats. The months of flowering are indicated by numerals placed after each species.

Section I. Euurginea. Flowers 6—13 mm. long; perianth lobes separate to the base.

(a) Flowers whitish, perianth lobes spreading, keeled with green or purplish-brown.

Raceme capitate. 1. U. Eckloni (10).

Raceme elongate.

Bulb globose; leaves 2—4, terete or sub-terete; fleshy; produced sheaths 10—15 cm. long.
2. U. exuviata (9—10).

Bulb globose; leaves 4—11, wiry; produced sheaths 1—6 cm. long. 3. U. filifolia (9—10).

Bulb scales 2-ranked; leaf single, terete; produced sheath very slender. 4. U. unifolia (10).

(b) Flowers brown, perianth lobes reflexing.
5. U. revoluta (2—3).

Section II. Pseudurginea. Flowers 3.5—6 mm. long; perianth lobes united into a tube which is very short in U. minor.

(a) Flowers solitary or in a few-flowered sub-corymbose raceme.

Peduncle 1—3 flrd., leaves sub-terete.
6. U. pygmaea (3).

Peduncle 2—6 flrd., leaves filiform. 7. U. minor (3—4).

(b) Raceme lax, very occasionally 1-flrd.; leaf single, terete. 8. U. gracilis (2—4).

(c) Raceme oblong, dense; leaf single, terete.
9. U. Dregei (2—3).

1. *Urginea Ekloni*, Baker; bulb whitish, laterally compressed, 8—22 mm. wide, bulb scales 2-ranked, inner tunics produced 2—6 cm. above the bulb, furnished with many strongly raised cross bars; leaf single, usually contemporaneous with the flower, terete, acute, glabrous, 10—27 cm. long, 1 mm. or less wide; peduncle slender, wiry, reddish-brown, finely mottled, 7—20 cm. long; raceme dense, capitate, up to 12 flowered; bracts of the lower flowers about 5 mm. long and conspicuously spurred, membranous; pedicels 3—5 mm. long; perianth lobes boat shaped, outer purplish, 6—8 mm. long and about 2 mm. wide, inner white, slightly broader than the outer, all conspicuously keeled below with green or brown; stamens a little shorter than the perianth segments, filaments filiform, 2—3 mm. long; anthers yellow, about 2 mm. long; ovary green, 3 mm. long and 2 mm. or less in diam.; style white, declinate, about 3 mm. long; capsule about 1 cm. long and 5 mm. wide, light brown in colour; seeds dark brown, flattened, 2—3 mm. wide, with a circular, membranous wing.

Stellenbosch Flats, in clayey ground, occasional; flowering in October. Plate V, figs. 4—8.

No material of this species is available for study in any of the South African herbaria and the species is unrepresented at Kew, but dried specimens of the Stellenbosch plant were compared with Ecklon's type specimen in the Berlin herbarium and reported by Dr. Krause to be identical with *U. Eckloni*, Baker.

The species may be recognised in the field by the 2-ranked bulb scales, the single leaf, the reddish and mottled peduncle and the compact, capitate inflorescence. The flowers, which have a sweet and delicate perfume, fruit very freely and as many as forty seeds may mature in a capsule.

2. *Urginea exuviata*, Steinh.; bulb globose, about 4 cm. diam., flesh yellowish, inner tunics produced 10—18 cm. above the bulb, with numerous, strongly marked transverse bars; leaves 2—4, as long as or overtopping the inflorescence, terete or sub-terete, glabrous, fleshy, up to 60 cm. long, 2—7 mm. broad below, tapering gradually to the apex; peduncle green or purplish-brown

in colour, up to 60 cm. long, 2—3.5 mm. wide, glabrous; raceme 10—20 cm. long, many flowered; lower pedicels 8—15 mm. long; bracts of lower flowers membrane edged, about 5 mm. long and 4 mm. wide, furnished with a basal spur 6—7 mm. long and 2 mm. wide; perianth sweet-scented, 10—13 mm. long, lobes separate to the base, whitish above, usually purplish below and with a well-marked purple-green keel, inner perianth lobes a little wider than the outer; stamens about half as long as the perianth, filaments filiform, white, about 6 mm. long and 0.5 mm. wide; anthers linear-oblong, about 3 mm. long, pale green in colour; ovary green, 3-angled, 4—5 mm. long; style whitish, declinate, 4—7 mm. long; stigma papillose; capsules up to 2 cm. long and 1 cm. or more wide; seeds numerous, flattened, with a circular wing; testa loose, membranous.

Stellenbosch Flats, in well-drained, sandy soil, rather rare; flowering September—October. Plate IV, figs. 1, 2, 4, 6, 8.

The bulb of this species is usually more massive than that of *U. filifolia* and the produced tunics are considerably longer and more conspicuously netted. All the living specimens examined thus far have from two to four leaves, and it is probable that most of the single-leafed specimens in herbaria belong to the allied species *U. unifolia*. A section through the fresh leaf shows a large amount of water-storing tissue with a small group of sclerenchyma associated with each vascular bundle, whereas the ground tissue of the leaf of *U. filifolia* is largely sclerenchymatous. The leaves of *U. exuviata* have been found to be attacked by a hitherto undescribed species of *Uromyces* which has been named *Uromyces Stellenbossiensis* by Dr. P. A. van der Byl.

3. *Urginea filifolia*, Steinh.; bulb globose, 2—3.5 cm. diam., outer tunics dark brown, inner produced 1—5.5 cm. above the bulb, furnished with cross bars; leaves 4—11, terete or more or less flattened, straight or somewhat flexuose, slender, wiry, glabrous, 14—26 cm. long, 0.5—2 mm. wide, shorter than or about equalling the inflorescence; peduncle slender, reddish-brown, 1—2 mm. diam. 12—35 cm. long; raceme 10—30 flrd.; lower pedicels 8—10 mm. long; bracts small, lower with a basal

spur 3—9 mm. long; perianth 8—12 mm. long, outer segments purplish, inner white and somewhat broader than the outer, all with well-marked purple or green keel; filaments filiform, much shorter than the perianth, about 5 mm. long; anthers linear-oblong, 1.5—2 mm. long; style white or purplish, declinate, 4—6 mm. long; ovary green, 2—4 mm. long; capsules membranous, 1 cm. or more long, about 0.5 cm. wide, edges of valves thickened; seeds numerous, oval, flattened, 3—4 mm. long, 2—3 mm. wide; testa dark brown, loose, membranous, produced into a circular wing.

Stellenbosch Flats, rather frequent on the First River Terrace; flowering in September. Plate IV, figs. 3, 5, 7, 9.

Dried specimens of *U. filifolia* and *U. exuviata* are liable to be confused, but in the fresh condition the two species are very distinct. *U. exuviata* has 2—4 terete or sub-terete fleshy leaves, while the leaves of *U. filifolia* are generally more numerous and wiry. The difference in leaf anatomy is considerable (Plate IV, figs. 4, 5) and can be recognised in sections of herbarium material. While the perianth lobes of *U. exuviata* are all of a purplish hue, the difference in colour between the inner and outer segments of *U. filifolia* is strongly marked, the outer segments being purplish and the inner opaque white except for the purple keel.

The perianth of *U. filifolia* is stated in Flora Capensis, Vol. VI, to be "inodorous". The flowers of the Stellenbosch plant possess a delicate but sweet scent.

4. *Urginea unifolia*, A. Duthie, n. sp.; bulbus albidus vel roseus, 2—3 cm. diam.; tunicae carnosae, in duos ordines constitutae, interiores in strictam vaginam scariosam, vittis transversis elevatis, productae; folium unicum, teres, 20—45 cm. longum, 1—3 mm. latum, synanthum; pedunculus purpureus, 11—30 cm. longus, 1—2 mm. latus, racemus elongatus, 3—13 fl.; bracteae inferiores membranaceae, 5—9 mm. longae, calcare ad 10 mm. longo; pedicelli inferiores 2—4 mm. longi, perianthium 7—10 mm. longum, albidum, infra purpurascens, segmenta distincta, viridi-carinata; filamenta filiformia, alba, ad 5.5 mm

longa, antherae flavae, ad 2 mm. longae, ovarium viride, ad 3.5 mm. longum et 1.5 mm. latum, stylus declinatus, albidus vel roseus, stigmate papillato; capsula 10—12 mm. longa, semina multa, compressa, testa laxa, fusca.

Stellenbosch Flats, in rather sandy soil; flowering in October. Herb. Univ. Stell., Flora Reg. Stell. 1891. Plate V, figs. 1—3. No. 11882, South African Museum Herbarium, is probably this species, as is also Marloth 7140 in the Herbarium of Dr. R. Marloth.

This species is allied to *U. exuviata,* Steinh., from which it may be distinguished by the 2-ranked bulb scales, closely clasping produced tunic and single leaf. It differs from *U Eckloni,* Baker, in the elongated raceme. All the specimens collected on the Stellenbosch Flats have flesh-coloured bulb scales, while the base of the leaf and inflorescence axis are purple. A specimen collected by Miss E. Markotter at Viswater near Riebeek Kasteel showed the purple bulb neck of the Stellenbosch plant, but the remainder of the bulb was colourless. The slender, corrugated sheath which is so striking a feature of the bulb in both *U. unifolia* and *U. Eckloni,* may reach a length of 7 cm.

5. *Urginea revoluta,* A. Duthie, n. sp.; bulbus globosus vel subglobosus, 1—4 cm. diam., dilute roseum; folium unicum, saepius synanthum, teres, 8—25 cm. longum, ad 1 mm. latum, glabrum; pedunculus gracilis, 15—31 cm. longus; racemus laxus, 5—20 fl.; pedicelli graciles, inferiores 10—15 mm. longi, recurvi, prope medium articulati; bracteae minutae, inferiores in latum calcar circa 1 mm. longum productae; perianthii segmenta 6—9 mm. longa, circa 2 mm. lata, distincta, patentissima, demum reflexa, fulva,* fusco-carinata; stamina erecta, filamentis filiformibus, ad 5 mm. longis; antherae 1.5 mm. longae, subconniventes; ovarium 3—4 mm. longum, 1.5 mm. latum; stylus 3—4 mm. longus; capsula fusca, 5—8 mm. longa, 3.5—5 mm. lata; semina nigra, sub-compressa.

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* Vinaceous Cinnamon with Orange Cinnamon or Mikado Brown keel. (Ridgeway's Colour Standard.)

Stellenbosch Flats, in sandy soil; occasional; flowering Feb. —March. Herb. Univ. Stell.; Flora Reg. Stell. 1874. Plate III, figs. 1—11.

The leaf appears as a rule with the young inflorescence, and by the time the flowers open the upper part is usually withered. Near the end of summer the bulbs are often much shrunken. The flowers open towards evening and remain open all night, closing about 8 or 9 the following morning. The poor development of fruit in this species is possibly due to the position of the essential organs which prevents self-pollination.

6. *Urginea pygmaea,* A. Duthie, n. sp.; herba pusilla; bulbus parvus, albidus, subglobosus, 3—10 mm. diam., hand vel minime saepe in collum productus; folia hysterantha, radicalia, 1—3, patentia vel adscendentia, sub-teretia, supra plana, carnosa, glabra, glauca, 2—4.25 cm. longa, basi 1 mm. diam. supra gradatim ampliata, ad apicem acuta; scapus 3—13 cm. longus, 1—3 fl.; pedicellis erectis, 2—4 mm. longis; bracteae parvae, membranaceae, 1 mm. longae, basi in calcar productae; perianthium 6—7 mm. diam., segmenta oblonga, obtusa, fulva, dorso late fusci-vittata, ad apicem minute papillata, basi in tubum brevem campanulatum connata; stamina erecta, fauci affixa, filamentis albidis, basi dilatatis; antherae 0.5 mm. longae; ovarium viride, subglobosum, 1.75 mm. longum; stylus albidus, 1 mm. longus; capsula globosa vel subglobosa, 4—5 mm. diam. membranacea; semina ad 2 mm. diam., testa nigra, laxa, membranacea, ad 24 in capsula.

Stellenbosch Flats, in sandy soil, occasional; flowering Feb. —March. Herb. Univ. Stell.; Flora Reg. Stell. 1603. Plate II, figs. 1—12.

This little species of Urginea is among the smallest known. When strongly illuminated the lamina is horizontal and often partly covered by the sand, while the peduncles are usually under 6 cm long. Grown in the shade the leaves are erect or sub-erect and the peduncles may reach a length of 13 cm. The raceme is as a rule 1-flowered; 2-flowered racemes are occasionally found, but 3-flowered racemes are very rare. The flowers open before noon and close towards evening. The anthers and stigma are

at approximately the same level and the filaments deliquesce soon after the flower closes. The high percentage of fruits matured is possibly due partly to self-pollination. The lower part of the perianth persists and forms a small, circular disc at the base of the capsule. In both *U. pygmaea* and the closely allied *U. minor* the globose capsule has a glistening appearance when mature. A fruiting specimen of *U. pusilla,* Baker, in the Bolus Herbarium shows capsules which in shape and iridescence are strikingly like those of *U. pygmaea* and *U. minor.* The details of the flower of *U. pusilla* as figured by Jacquin (Ic. ii, 18, t. 417) agree very closely with those of *U. minor.*

7. *Urginea minor,* A. Duthie, n. sp.; bulbus albidus, 5—12 mm. diam., saepius in collum productus; folia 3—5, erecta, filiforma, supra saepe leviter canaliculata, acuta, glabra, 2—10 cm. longa, 0.5 mm. lata, hysterantha; scapus 3—12 cm. longus, 1—6 fl.; pedicelli erecti vel adscendentes, inferiores 5—8 mm. longi; bracteae inferiores basi infra insertionem in calcar productae; perianthii segmenta oblonga, obtusa, ad 4 mm. longa, 1 mm. lata, supra albida infra fusco-carinata, ad apicem minute papillosa, basi in brevissimum tubum connata; filamenta albida, compressa, 1.5 mm. longa, in medio 0.33 mm. lata; antherae 0.5 mm. longae; ovarium albidum, subcylindricum, 1—1.25 mm. longum, ad 1 mm. diam.; capsula subglobosa, 3—5 mm. diam., membranacea; semina subcompressa, 2—3 mm. longa, testa nigra, laxa, membranacea.

Stellenbosch Flats, in clayey and gravelly ground, locally frequent; flowering March—April. Herb. Univ. Stell.; Flora Reg. Stell. 1546. Plate II, figs. 13—21.

This species is associated with *Relhania ericoides, Eriospermum parvifolium* and other plants of the local "grey bush" community. The flowers open about 5 p.m. and close an hour or two later. The capsules resembles those of *U. pygmaea* very closely, and as in that species it is possible that the high percentage of fruit matured is the result of self-pollination aided by the deliquescence of the filaments.

U. minor differs from *U. pygmaea* in habitat, leaf form, shorter perianth tube, colour of flower and shape of filament. The peduncles are usualy longer and the number of flowers produced greater. In the fruiting stage the species are very similar and readily confused. Two inflorescences are sometimes produced by one bulb in the same flowering season, and occasional vegetative reproduction by means of bulbils has been observed in this species.

8. *Urginea gracilis*, A. Duthie, n. sp.; bulbus albidus, 7—18 mm. diam., in collum 1—3.5 cm. longum productus; folium unicum, teres, suberectum, hysteranthum, 6—13 cm. longum, ad 1 mm. latum, glabrum, ad basim roseum; pedunculus gracilis, 4—50 cm. longus, ad 0.33 mm. diam.; racemus 1—40 fl.; pedicelli inferiores 1—2 mm. longi, ad basim articulati; bracteae circa 0.5 mm. longae, calcare 1—1.25 mm. longo; perianthium 5—6 mm. longum, segmenta aequalia, ad 1.5 mm. lata, supra alba, brunneo vel viridi-carinata, patentissima, demum reflexa, basi in brevem tubum connata; filamenta erecta vel suberecta, fauci perianthii affixa, alba, 2.5—4 mm. longa; antherae ad 1 mm. longae; ovarium 2—2.5 mm. longum, circa 1 mm. latum, viridi-vittatum; stylus albidus, 1.5—2 mm. longus, stigmate parvo; capsula erecta, ovoidea vel cylindrica, acuta, 4—12 mm. longa, 2—3 mm. lata; semina compressa, 2—4 mm. longa, 0.5—1 mm. lata, testa nigra, membranacea.

Stellenbosch Flats, margins of seasonal swamps and in low-lying, clayey or gravelly areas which are wet during the winter; frequent; flowering February—April. Herb. Univ. Stell.; Flora Reg. Stell. 1446. Plate I, figs. 6—14.

Of the unnamed sheets in the Bolus Herbarium No. 17005 (Camp Ground, Rondebosch, March, 1921. Leg M. M. Page) matches the Stellenbosch racemes exactly, but leaf and bulb are wanting. Schlechter's 9962 (in montibus pone Mitchell's Pass, 15.1.1896) and 10390 (Onrustrivier, in arenosis prope Hermanus-pietersfontein, 10.4.1897) also resemble the Stellenbosch species, but the specimens are again incomplete.

This is the commonest species of *Urginea* found on the Stellenbosch Flats. In is allied to *U. Dregei,* which it resembles in the single, terete leaf as well as in the floral characters, but it differs from that species both in habitat and in the more slender and lax raceme. Specimens vary greatly in size and 1-flowered peduncles are sometimes found. The flowers, which are very sweetly scented, open in the afternoon and close again during the evening. About 50 per cent. of the flowers produce capsules.

9. *Urginea Dregei,* Baker; bulb globose or subglobose, 2.5—4 cm. diam., occasionally with a neck 1—5 cm. long; flesh of bulb-scales whitish; leaf usually developed after the flowers, single, terete or somewhat flattened above, erect or suberect, 10—45 cm. long, 1—4 mm. diam., tapering more or less abruptly to the apex and callous tipped, surface glabrous, dark-green, pink* towards the base; peduncle 45—72 cm. long, about 2 mm. diam., bearing 30—60 flowers in a dense, cylindrical raceme; pedicels of lower flowers 3—5 mm. long, with absciss layer at base; bracts minute, membranous, about 1 mm. long, the lower with a cylindrical spur; perianth about 1 cm. diam., segments white, 4—5 mm. long, 2 mm. broad, keeled below with brown, spreading and later somewhat reflexed, united into a short tube at base; filaments white, about 4 mm. long, the lower half united with the perianth tube; anthers yellow, about 1 mm. long; ovary green, about 3 mm. long, a little over 1 mm. wide at base; style white, about 2 mm. long; stigma minute, slightly papillate; capsule 6—8 mm. long, 2—3 mm. wide; seeds compressed, 4—5 mm. long, 1—2 mm. wide, with a dark-brown, loose, membranous coat.

Stellenbosch Flats, in stony and sandy soil, occasional; flowering February—April. Plate I, figs. 1—5.

Baker describes the leaf as linear, but the co-type at the Bolus Herbarium shows a terete leaf, the lower part of which has been somewhat flattened in pressing. On the Stellenbosch Flats the leaf is either quite undeveloped or from 1—7 cm. long

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* Congo Pink or Terra Cotta (Ridgeway's Colour Standard)

at the time of flowering. The perianth lobes are united at base into a short tube which is from 1—2 mm. long. This tube is very distinct in the living flower or in specimens preserved in alcohol. It is less obvious in dried material and great care is needed in dissecting a soaked flower, as the delicate tissue is easily torn. The flowers open during the evening and remain open all night, closing again about midday. The fruiting is very uneven. Some racemes do not set seed at all, others may mature from 1—13 fruits.

EXPLANATION OF ILLUSTRATIONS

PLATE I.

Figs. 1—5 : U. Dregei.
Fig. 1 : Part of flower, side view.
Figs. 2—4 : Capsules.
Fig. 5 : Seeds.
Figs. 6—14 : U. gracilis.
Figs. 6 : Fruiting raceme.
Fig. 7 : Stunted plant with single fruit.
Fig. 8 : Bract.
Figs. 9—10 : Flower.
Figs. 11—13 : Capsules.
Fig. 14 : Seeds.

PLATE II.

Figs. 1—12 : U. pygmaea.
Fig. 1 : Leafing plant, grown in the sun.
Fig. 2 : Leafing plant, grown in the shade.
Fig. 3 : Transverse section through leaf.
Figs. 4—6 : Capsules.
Fig. 7 : Seeds.
Fig. 8 : Seeds with loose testa removed.
Fig. 10 : Part of perianth with epiphyllous stamens
Fig. 11 : Stamen.
Fig. 12 : Pistil.
Figs. 13—21 : U. minor.
Fig. 13 : Leafing plant.
Figs. 14—15 : Inflorescence.
Fig. 16 : Stamen.

Fig. 17 : Pistil.
Figs. 18—19 : Capsules.
Fig. 20 : Seeds.
Fig. 21 : Seeds with loose testa removed.

PLATE III.

Figs. 1—11 : U. revoluta.
Fig. 1 : Flowering plant.
Fig. 2 : Fruiting plant.
Fig. 3 : Part of inflorescence showing spurred bract and withered flower.
Fig. 4 : Bract.
Fig. 5 : Stamens and pistil.
Fig. 6 : Pistil.
Fig. 7 : Transverse section through ovary.
Figs. 8—10 : Capsules.
Fig. 11 : Seeds.

PLATE IV.

Fig. 1 : U. exuviata, fruiting.
Fig. 2 : U. exuviata, bulb with produced tunics.
Fig. 3 : U. filifolia, fruiting.
Fig. 4 : U. exuviata, transverse section through leaf.
Fig. 5 : U. filifolia, transverse section through leaf.
Figs. 6 and 8 : U. exuviata, stoma.
Fig. 7 and 9 : U. filifolia, stoma.

PLATE V.

Figs. 1—3 : U. unifolia.
Figs. 4—5 : U. Eckloni.
Fig. 6 : U. Eckloni, spurred bract.
Fig. 7 : U. Eckloni, stamen.
Fig. 8 : U. Eckloni, pistil.

PLATE I.

PLATE II.

PLATE III.

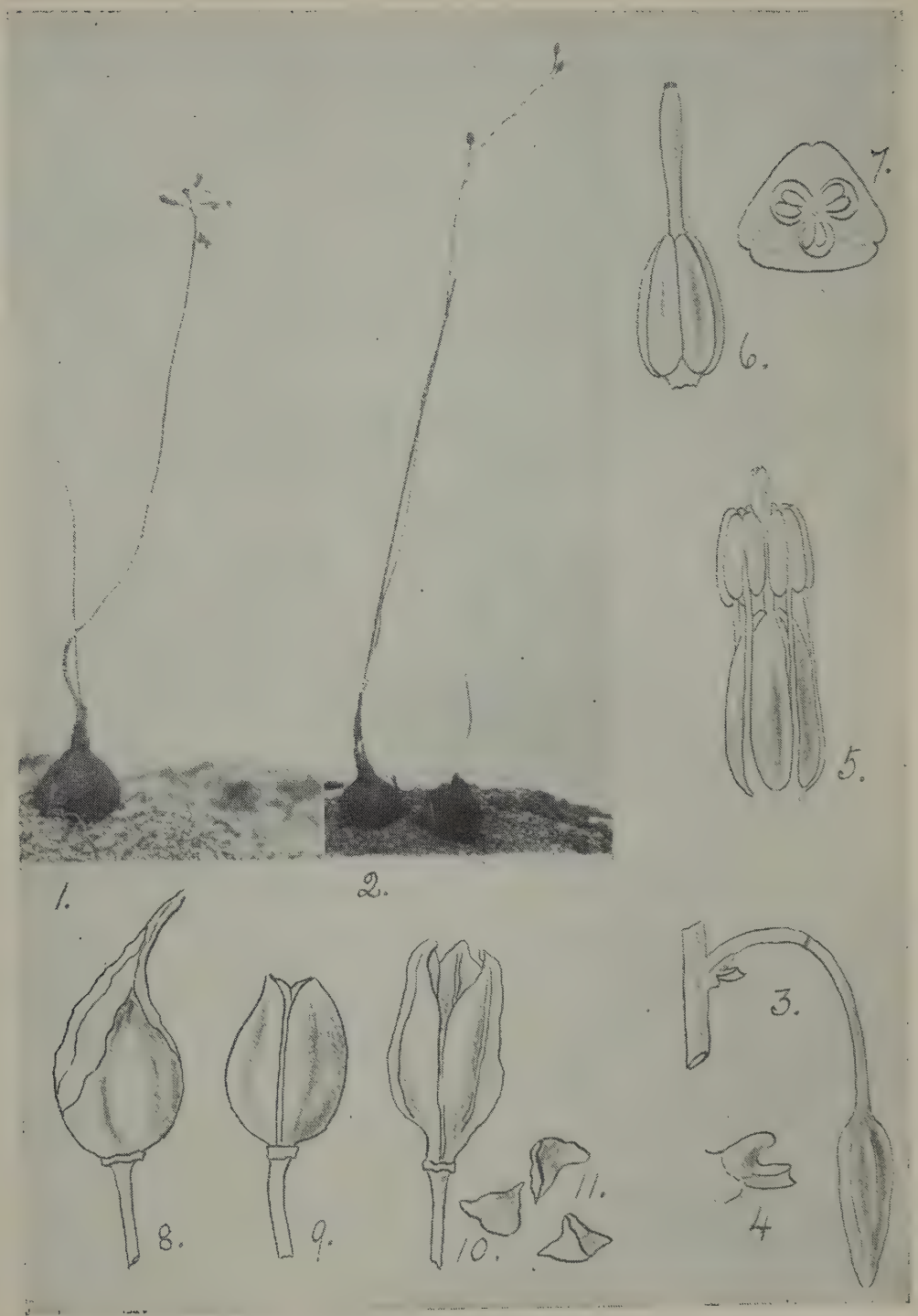
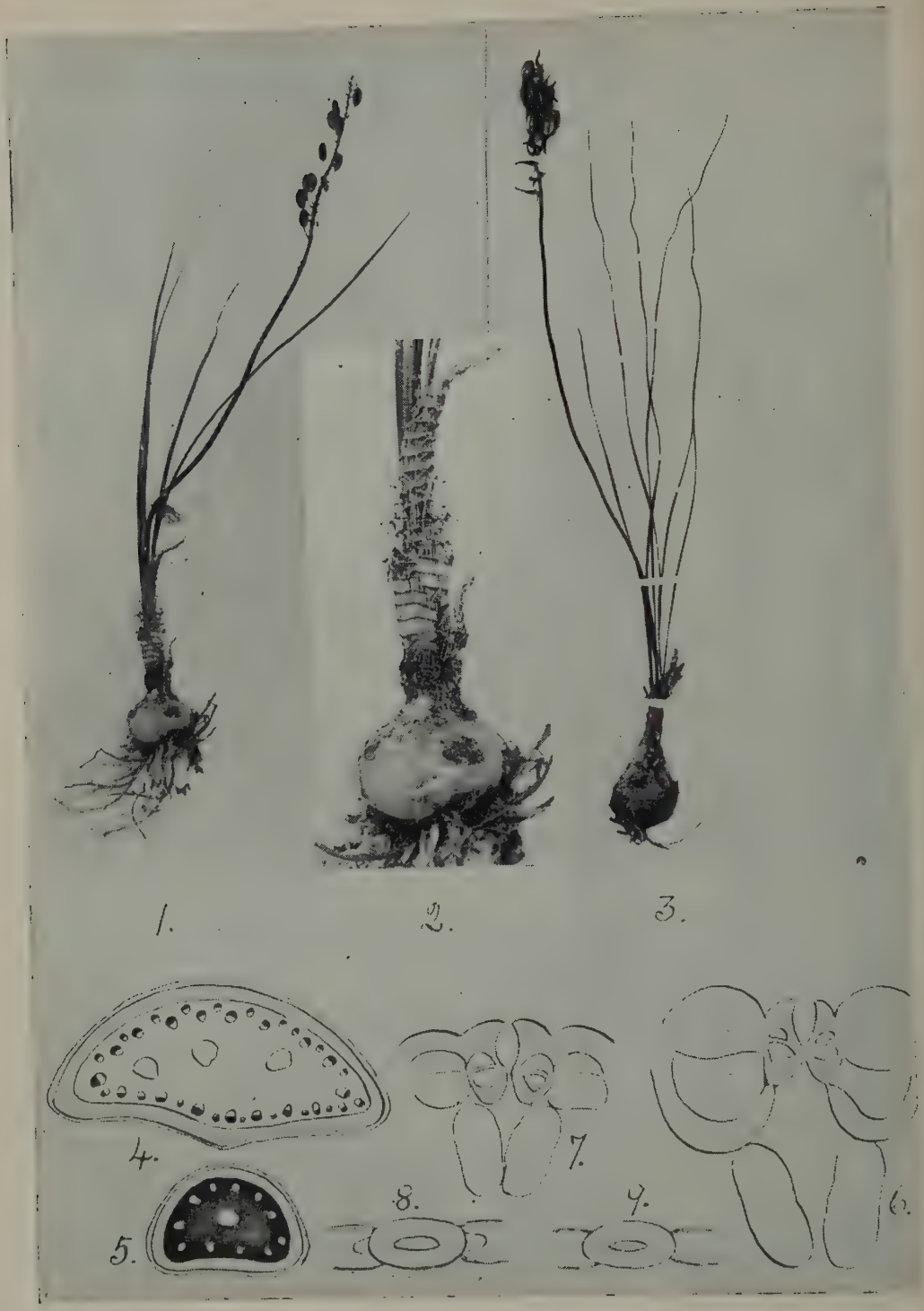


PLATE IV.



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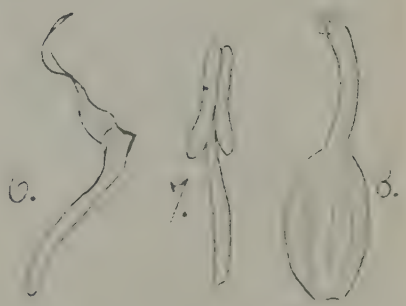

6. 7. 8.

CONTRIBUTION TO OUR KNOWLEDGE OF THE STELLENBOSCH FLORA.

NEW OR LITTLE KNOWN FLOWERING PLANTS OF THE STELLENBOSCH FLATS.

BY

A. V. DUTHIE

The intensive study of the flora of the Stellenbosch Flats has brought to light some twenty or more hitherto undescribed species of flowering plants, one of which, *Ornithogalum pygmaeum,* is described in the present paper. In addition to these new species are others—quite as interesting—which after being collected by one or another of the early botanical travellers have been lost sight of completely, sometimes for a period of 100 years. Such a plant is *Haemanthus Pumilio,* which is unrepresented in any of the European or South African herbaria and has, until recently, been known only from Jacquin's coloured plate. Another is the beautiful "bloukeur"—*Psoralea Gueinzii* —which appears to have been collected by both Thunberg and Gueinzius, though the locality in which the specimens were gathered is uncertain. Yet another is the two-petalled Pelargonium, *P. trifoliatum,* originally collected by Drège at Klein Drakenstein and described by Harvey from the very imperfect material which reached Europe. *Albuca fibrosa* was described by Baker from a plant which flowered at Kew in 1874. The bulb was collected by a Mr. Bennett in South Africa, but the locality was not recorded and even the Kew Herbarium does not possess a type specimen. *Pelargonium multifidum* was collected by Zeyher between the Swartberg and Rivier-Sonderend. Harvey's description in the Flora Capensis is incomplete in several respects on account of the imperfections of the dried specimens examined.

The descriptions of the species given in the present paper are based upon the examination of large quantities of fresh material collected both in the flowering and fruiting stages. I am indebted to Mr. L. Verwoerd and to Mr. H. Herre for the photographs here reproduced.

1. *Ornithogalum pygmaeum,* A. Duthie, n. sp.; bulbus globosus, 0.5—1.5 cm. diam., saepissime in collum 1—4 cm. longum productus; folia radicalia, fasciculata, 10—30, exterius vaginatum vagina integra, cetera filiformia 1—6 cm. longa, 0.5—1 mm. lata, superne subtriquetra, marginibus dorsoque minute denticulata; pedunculus gracillimus, 2.5—8 cm. longus; racemus laxus, cylindricus vel plus minusve distichus 1—9 fl.; bracteae membranaceae, albidae 3—8 mm. longae, ad basim circa 1.5 mm. latae, deltoideae cuspidatae; pedicelli erecti vel suberecti, inferiores 1—3 cm. longi; perianthii segmenta alba, dorso brunneo- vel viridi-vittata, exteriora 4—5 mm. longa, circa 2 mm. lata, interiora 3—4 mm. longa, 2 mm. lata, apice minute ciliato; stamina perianthio breviora, filamentis lanceolatis 2.5 mm. longis circa 1 mm. latis; ovarium ovoideum, album, stylum excedens; capsula membranacea, 2.5 mm. longa, circa 2 mm. lata, perianthio persistente inclusa; semina minuta, nigra.

Stellenbosch Flats, in clayey ground, locally common; leafing April—August, flowering November—December. Herb. Univ. Stell., Flora Reg. Stell. 1505. Plate I, figs. 1—7.

This is the smallest *Ornithogalum* found on the Stellenbosch Flats. The little, green leaf-tufts, 1—1.5 cm. across, appear in the winter. The subterranean, colourless bases of the foliage leaves are enclosed in a tubular sheath belonging to the oldest leaf of the tuft. The free lamina of this sheath is usually slightly shorter and broader than the projecting apices of the younger leaves and like them is furnished along the margins with minute, tooth-like tubercles. This species was collected by Schlechter (9068. Ceres Rd. in lapidosis, 800′, 10.XI.19.) and distributed by him under the manuscript name *O. maximiliana,* but does not appear to have been published. Schlechter's specimen in the Bolus Herbarium consists of two flowering scapes, one of which is attached to a bulb. The leaves are not represented.

2. *Haemanthus Pumilio,* Jacq.; bulb compressed, 2—4.5 cm. diam., 3—7 cm. long, tunics thick, bifarious, produced above into a more or less distinct neck; leaves 1—2, developed after the flowers, somewhat fleshy, erect or sub-erect, lorate, straight or spirally twisted, 10—16 cm. long, 0.33—1 cm. broad, glabrous, dark green in the upper half, paler towards the base and barred and spotted on both surfaces with red-brown; peduncle slender, 5—22 cm. long, 2—4 mm. wide, elliptical in section, red or finely mottled; flowers 2—16 in an umbel, pedicels 1—11 mm. long; bracts 3—6, oblong-lanceolate, 10—28 mm. long, 2—7 mm. wide, erect or more or less spreading, whitish or pink in colour; perianth white or pink,* segments linear, 8—13 mm. long, 1—2 mm. wide; filaments about 10 mm. long and 0.5 mm. wide; anthers yellow, 1 mm. long; ovary sub-globose or cylindrical, 2—4 mm. long; berry reddish, sub-globose, 3—10 mm. diam., 1—3 seeded; seeds green or reddish.

Stellenbosch Flats, locally frequent in low-lying, clayey areas, but occurring also in sandy soil; flowering March—April. Plate I, fig. 8; Plate II, fig. 1.

This striking little species agrees closely with Jacquin's figure (Hort. Schoenbr. 1.32, t. 61). In clayey ground the inflorescences are often stunted and some of the finest specimens have been found in sandy places under the shade of pine trees.

3. *Albuca fibrosa,* Baker; bulb ovoid, 1—2.5 cm. in diameter, solid, with yellowish flesh; outer tunics splitting into long, fine, persistent bristles which are more or less perfectly connected by transverse bars; leaves 1—2, terete, or sub-terete, glabrous, somewhat glaucous, 15—30 cm. or more long, channelled down the face; peduncle glabrous, terete, 15—30 cm. or more long, laxly 1—6 flowered; pedicels cernuous, usually about 1 cm. long, in exceptionally well-grown plants up to 2 cm. long; bracts lanceolate, 5—12 mm. long; perianth 1.5—2.5 cm. long, segments pale yellow, broadly keeled with green; outer stamens sterile; style prismatic, longer than the oblong ovary; capsule membranous, about 1.5 cm. long; seeds compressed, 3—4 mm. long, testa dark brown.

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* Rose Pink (Ridgeway's Colour Standard).

Stellenbosch Flats, in somewhat sandy soil, frequent in transition area between Passerina-Cliffortia association and "grey bush"; flowering end of October to November; fruiting end of November to December. Plate II, figs. 2—4.

This species is allied to *Albuca exuviata* with which it agrees in the solid bulb and fibrous tunics, but differs in the length and position of the pedicels, the character of the ovary and the geographical distribution. *Albuca fibrosa* has probably been confused in the past with *A. minor*. It usually flowers later than that species and the vegetative characters of the two are very distinct.

4. *Pelargonium multifidum*, Harv.; shrubby, erect, much branched, branches slender, angular, pubescent, the older parts covered with rusty, fissured bark; leaves petiolate, sub-rotund in outline, 3—7 parted, the segments cuneate, deeply incised, both surfaces thickly covered with rigid, white, adpressed hairs; petioles up to 1 cm. long, hairy, persisting after the blades have fallen; lamina up to 12 mm. broad, articulated to the apex of the petiole; stipules broadly subulate, adnate, hairy; peduncles filiform, persistent, up to 3 cm. long, usually 2-flrd. occasionally 1-flrd.; calyx tube usually sub-sessile, pubescent, up to 3 cm. long, segments oblong, obtuse, hairy, up to 9 mm. long, the posterior erect or sub-erect, the remainder reflexing; petals subequal, spathulate, not much exceeding the calyx lobes, dull yellow or terra cotta,* usually darker veined, posterior petals often erect or sub-erect, the anterior and lateral reflexing; 7 stamens as a rule bearing anthers; fruits 2—5 cm. long, all 5 carpels fertile or 1—4 abortive, surrounded at base by the erect calyx lobes.

Stellenbosch Flats, in clayey ground, occasional, flowering November—April, leafing in the winter. Plate III.

This species of *Pelargonium* occurs in the "grey bush" community of the Stellenbosch Flats, but is nowhere abundant. In summer the shrubs, which may reach a height of about 30 cm., appear dry and dead except for the dull coloured flowers and young fruits. The stems are gnarled and are covered with

* Terra Cotta and Etruscan Red (Ridgeway's Colour Standard).

a rusty and often fissured bark, while the persistent inflorescence axes and petioles of the previous season give a spinous appearance to the whole plant. The changed aspect in the winter when the branches are closely covered with green leaf-tufts is very striking. The flowers have a sweet and delicate perfume which is very noticeable at night. In all the material examined only a single 3-flowered umbel has been observed.

P. multifidum has been confused with *P. abrotanifolium*, but differs from the latter species in habit, pubescence and leaf and floral characters. Since this species was first found on the Signal Hill by Miss Guthrie and by the writer on the Stellenbosch Flats specimens have been collected in several other localities.

5. *Pelargonium trifoliatum*, Harv.; stemless, tuberous rooted; leaves on long, hairy petioles, tripartite, hairy on both sides, the segments broadly cuneate, variously lobed; stipules membranous, adnate to the petiole; scapes slender, hispid, 4—11 cm. long, bearing from one to four umbels; umbels 4—8 flowered; calyx sub-sessile, tube hispidulous; calyx segments lanceolate, about 6 mm. long and 1.5 mm. wide, reflexing; petals spathulate, 10—16 mm. long, 0.66—1 mm. wide below, 2—4 mm. wide above, pink in colour with darker markings; fertile stamens four; pollen scarlet.

Stellenbosch Flats, occasional on First River Terrace; flowering Feb.—May, leafing in winter. Plate IV, figs. 1—6.

Pelargonium trifoliatum occurs in some abundance on the hills and mountain slopes in the Stellenbosch District. It is rather rare on the First Terrace, and though it extends to the Second Terrace, it has not been found in flower on the lower ground. In spite of the poor condition of the specimens collected by Drège, Harvey's description in Flora Capensis is accurate though necessarily incomplete. The leaves, which vary much in incision even in a single plant, are produced in the winter. The colour of the petals ranges from white or very pale pink in freshy opened flowers to bright pink in those which have shed their pollen. Flowers which have opened in the house are usually dead white with Aster Purple* markings on the petals and staminal tube, and scarlet pollen. These flowers remain white until the petals fall.

* Ridgeway's Colour Standard.

In the study of this species several interesting abnormalities were noted. One flower was found to possess a normal and a lobed petal, another showed three petals of unequal size, while four flowers had three petals of normal size and marking in place of the two characteristic of the species. Several of these flowers with abnormal petals exhibited abnormalities in calyx or androecium.

6. *Psoralea Gueinzii,* Harv.; tall, erect, much branched, branches slender, closely leafy, the younger half-herbaceous, longitudinally striate and villous; leaves of adult plant variably pubescent, sub-sessile, unifoliate or rarely 2 to 3-foliate; leaflets lanceolate, acuminate, complicate, about 2.5 cm. long and 3—4 mm. wide, apex very acute, almost pungent; stipules herbaceous, ovate-cuspidate, striate; pedicels axillary, 5—6 mm. long, bracteolate above the middle, bracteoles connate, the one deeply lobed; calyx tube campanulate, about 2 mm. long, calyx lobes lanceolate, acuminate, ciliate, the lowest 5 mm. long; flowers violet, about 13 mm. long, legume indehiscent, one-seeded, seed 5 mm. long, 3 mm. wide.

Stellenbosch Flats, in seasonal swamp, growing with *P. pinnata,* Linn., flowering Oct.—Feb. Plate IV, fig. 7.

Harvey's description of this species in Fl. Cap. Vol. II. was based upon material collected by Thunberg and Gueinzius, presumably in the Cape District. There is no type specimen of *P. Gueinzii* for comparison at Kew or in any of the South African herbaria, but the Stellenbosch plant agrees so exactly with the description in Flora Capensis that I have no hesitation in assigning it to this species. A single adult specimen of the plant, some five feet high, was found during 1925 in the seasonal swamp at the back of Dag Breek. This has, unfortunately, died, but cuttings taken from it by Mr. H. Herre are flourishing in the Botanical Garden of the University and are flowering and fruiting freely. These juvenile plants have produced tri-foliate leaves on the main axis, the lower with petioles up to 6 mm. long and with a central leaflet 3 cm. or more in length and up to 7 mm. broad, the upper sub-sessile and sometimes bi-foliate. The leaves of the lateral branches resemble those of the adult plant in being

sub-sessile and uni-foliate. The violet-coloured* flowers are among the handsomest in the genus and are bee-pollinated. The tip of the carina and upper part of the vexillum are darker than the rest, and there is in addition an inverted V-shaped mark of darker violet at the base of the standard.

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* Mauve or Light Violet, darkening to Light Purple or Dark Violet. (Ridgeway's Colour Standard.)

EXPLANATION OF ILLUSTRATIONS.

PLATE I.

Figs. 1—7: Ornithogalum pygmaeum.
Fig. 2: Outer sheathing leaf.
Fig. 3: Ordinary foliage leaf.
Fig. 4: Bract.
Fig. 5: Outer perianth lobe and stamen.
Fig. 6: Inner perianth lobe and stamen.
Fig. 7: Pistil.
Fig. 8: Haemanthus Pumilio, in flower.

PLATE II.

Fig. 1: Haemanthus Pumilio, in leaf.
Figs. 2—4: Albuca fibrosa.
Fig. 2: Plants with flowers and leaves.
Fig. 3: Bulbs.
Fig. 4: Pistil.

PLATE III.

Figs. 1—9: Pelargonium multifidum.
Figs. 2—3: Opening buds.
Figs. 4—5: Flowers.
Fig. 6: Staminal tube, posterior view.
Fig. 7: Staminal tube, side view.
Fig. 8: Staminal tube, split open and unrolled.
Fig. 9: Leaf.

PLATE IV.

Figs. 1—6: Pelargonium trifoliatum.
Fig. 1: Leaf variation.
Fig. 2: Staminal tube, cut down anterior edge.
Fig. 3: Flower.
Figs. 4—6: Abnormal petals.
Fig. 7: Psoralea Gueinzii.


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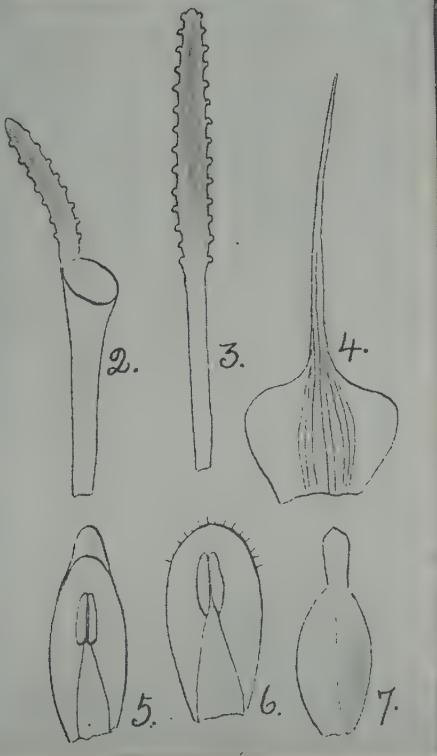
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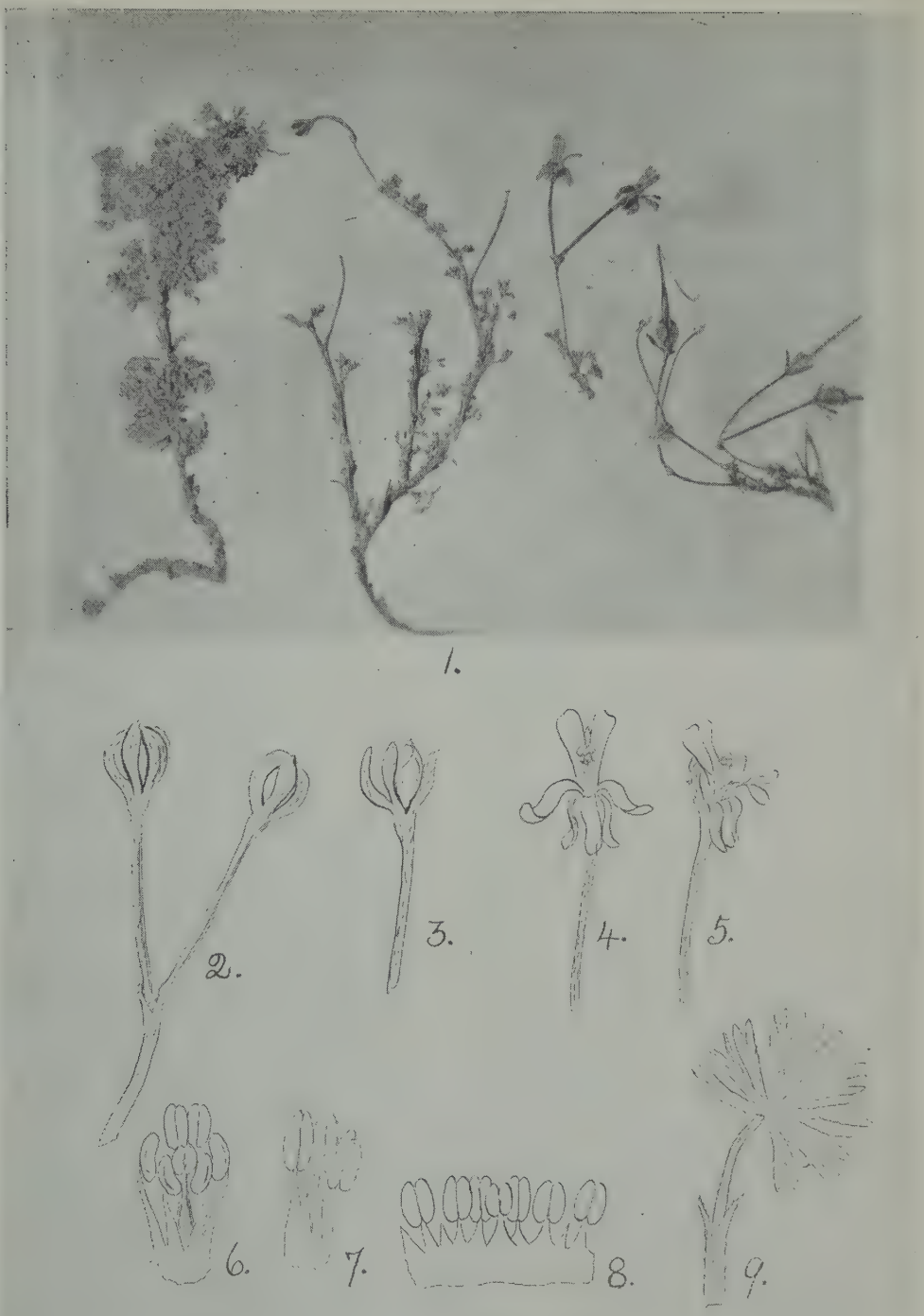
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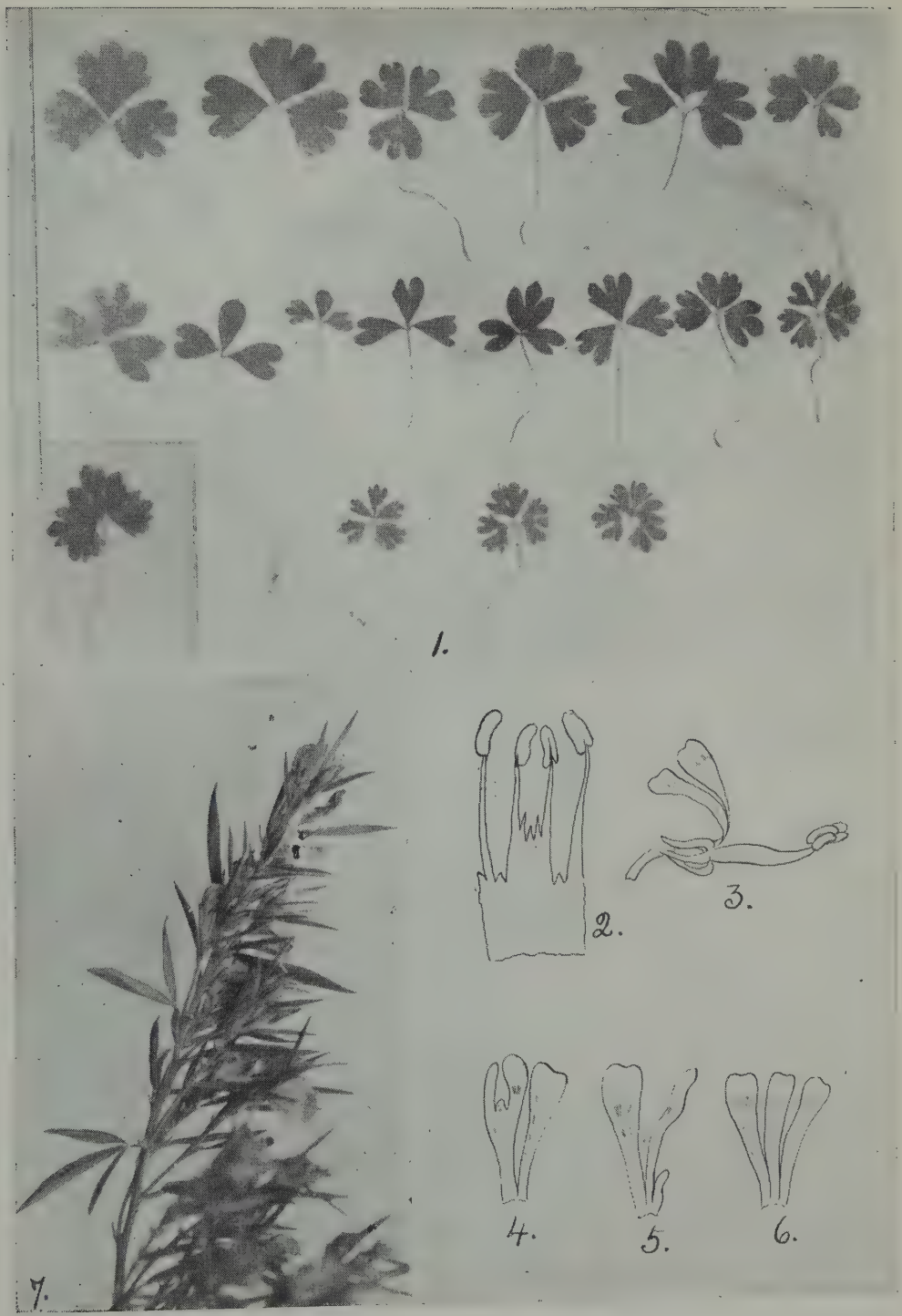
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DIE SNOEI VAN BLAARWISSELENDE VRUGTEBOME.

'n Mededeling oor Snoeiproewe met Vrugtebome op die Uniwersiteitsplaas, Stellenbosch. 1922—1928.

DEUR

O. S. H. REINECKE,

Professor in Vrugteteelt, Stellenbosch-Elsenburg Landbou-kollege van die Uniwersiteit van Stellenbosch.

'n Jong vrugteboom wat gesnoei is, vorm 'n aantal weelderige lote, en daarom is die boer gewoonlik bereid om aan te neem dat so 'n boom deur snoei geprikkel en versterk word. Dit is 'n bekende waarneming dat van die oë wat naaste geleë is aan die snyplek, een of meer weelderige lote ontstaan. Die snoei het dus blykbaar 'n prikkelende invloed op dié oë gehad. Hierdie algemene waarneming het aanleiding gegee tot die mening dat kort snoei van bome in hul eerste jare vir die boer die voordeligste praktyk is.

In hierdie mededeling sal bewyse gelewer word dat kort snoei nie 'n gewenste praktyk is met pruim- en peerbome nie. Aangesien kort snoei van jong vrugtebome die algemene snoei-behandeling in Suid-Afrika is, en deur lang gebruik 'n diep gewortelde praktyk geword het, sal dit egter raadsaam wees om hier eers 'n algemene oorsig te gee van die invloed wat snoei op die lewensrigtinge van 'n boom uitoefen. Die vraag is: As sekere oë geprikkel word om sterk-groeiende lote te ontwikkel, word die boom as geheel daardeur vergroot en versterk?

Dit word meestal aangeneem dat as gevolg van die wegknip van 'n gedeelte van 'n tak, daar 'n kleiner aantal groeipunte oorbly, wat 'n groter hoeveelheid van die opgestoorde plantvoedsel tot hul beskikking het, en wat dus beter kan groei Verder word gemeen dat die lote wat afgesny is, in verhouding met hul gewig, 'n groot aanteelweefsel oppervlakte besit, terwyl die ouere gedeeltes van die boom, wat veral dien om plantvoedsel op te bêre, nie deur die snoei verwyder word nie. Die mening is dus dat deur die snoei die kambium-area en die aantal groeipunte verminder word, en dit sonder om inbreuk te doen op die reserwe-plantvoedsel wat in die ouere takke opgegaar is. Die logiese uitwerking van hierdie teorie behoort te wees, dat as gevolg van die oormaat plantvoedsel, al die onderdele van die boom sowel as die boom as geheel vergroot sal word. Bewyse inteendeel kan gelewer word dat snoei die wortelsisteem verklein, en bogemelde verklaring kan dus nie aangeneem word nie.

Die resultate van noukeurige proefnemings van Chandler, toon aan dat die gevolge van snoei is, nie alleen om die blaaroppervlakte van 'n boom te verminder nie, maar dat die groei van beide die bogrondse en die ondergrondse dele ook nadelig daardeur beïnvloed word.

Chandler het in Missouri met perskebome bewys dat kort snoei in die winter die blaaroppervlakte van die boom verminder. By Cornell is soortgelyke proewe geneem, en van die resultate wat verkry is, word die volgende tabel ontleen.

TABEL 1.—UITWERKING VAN SNOEI OP BOME IN DIE KWEKERY.

Behandeling	Aantal bome	Gemiddelde blaaroppervlakte in vierkante duim in Mei, 1918, voor snoei toegepas is	Gemiddelde blaaroppervlakte in vierkante duim in Mei, 1918, na snoei toegepas is	Gemiddelde blaaroppervlakte in vierkante duim in September, 1918	Gemiddelde gewig (gram) van bogrondse gedeelte van boom plus gesnoei de lote in Mei, 1919	Gemiddelde gewig (gram) van wortels van bome in Mei, 1919
Ongesnoei	41	756·48	756·48	1737·94	684·0	208·5
Matig gesnoei	33	819·14	470·27	1219·80	558·3	166·9
Kort gesnoei	39	775·70	291·61	895·96	493·3	125·3

Uit Tabel 1 kom dit voor dat snoei die blaaroppervlakte verklein, en dat die wortels sowel as die bogrondse dele van die boom (stam, takke, ens.) verminder word. Deur die knip van die boom word oë weggeruim wat lote en blare by die begin van die groeiperiode sou ontwikkel het, maar sulke gesnoeide takke vorm inteendeel meer langlote wat voorsien is met groter blare. Die verskil dus in blaaroppervlakte tussen gesnoeide en ongesnoeide bome, is grootste in die lente, en neem af namate die groeiseisoen vorder. Tog kan ons verstaan dat die ongesnoeide boom vir 'n langer periode voorsien is met sy groot blaaroppervlakte, en dat so 'n boom in staat is om 'n groter hoeveelheid plantvoedsel te bêre. Gardner het bewys dat die inkort van takke die aantal kortlote veral verminder, en dat snoei dus veral die blare op sulke kortlote verminder. Die mening is dat die blare op kortlote 'n groter rol speel dan die blare op langlote, wat gevorm word gedurende die loop van die groeiseisoen, en wat dus die boom vir slegs 'n deel van die groeijaar kan bedien. Die kortloot-blare is klein, en word baiemaal buite rekening gehou, veral by appels en pere; terwyl 'n mens alte geneig is om aan te neem dat die groot lowergroen-blare op gesnoeide langlote 'n teken is van 'n versterkte boom. Kortliks kan ons dus sê dat snoei die totale blaaroppervlakte van klein blare op kortlote tot 'n groter mate verminder dan wat vergoed kan word deur die groot blare wat later gevorm word op langlote, wat na aan die snoeiplekke ontstaan.

Volgens Sprenger, was Sieulle, 'n Franse tuinbaas, waarskynlik die eerste tuinbouer wat die verklaring in 1806 gemaak het dat ongesnoeide bome groter oeste sal oplewer. Gillekens het in 1863 in België gunstige resultate met ongesnoeide bome in vergelykende snoeiproewe verkry. Die idee van minder snoei, egter, het onder vrugteboere op die Vasteland nie posgevat nie, en teen die einde van die laaste eeu het Goethe in Duitsland weer die aandag daarby bepaal dat die snoei van jong bome 'n verswakkende uitwerking op hul groeikrag uitoefen. Bedford en Pickering in Engeland het in die daaropvolgende jare waardevolle proewe gemaak oor die jaarlikse inkorting van langlote, en getoon dat ná elf jaar getopte bome heelwat ligter dan ongesnoeide bome was, en dat die verskil groter was as die gewig van die hout wat deur die snoei verwyder is. Bewyse is deur hul gelewer dat die

gesnoeide bome, alhoewel hul 'n uiterlike voorkome van meer weelderige groei vertoon het, in werklikheid tog minder gegroei het as ongesnoeide bome.

Dergelike proewe met ooreenkomstige resultate is gemaak in Virginia deur Alderman en Auchter met appelbome; in California deur Biolettii met olyfbome en deur Tufts met peer-, perske-, appelkoos-, pruim- en kersiebome; deur Cullinan en Baker in Indiana met appelbome; en deur Chandler in New York met appel-, peer-, perske-, drie spesies van pruim- en twee spesies van kersiebome.

Omrede dat soortgelyke proefresultate van die suidelike halfrond nie beskikbaar was nie, is in 1922 'n begin gemaak met snoeiproewe op Stellenbosch. Die doel van hierdie proewe was verder ook om gegewens in te wen om rigting aan ons boere te gee in verband met hul snoeiprobleme. Vir die snoeiproewe was Santa Rosa-pruime, Bon Chretien- en Beurre Hardy-pere, en Royal-appelkose gebruik, en die snoeipersele is sorgvuldig uitgesoek om sover as moontlik uniformiteit van grond en boomgehalte te verkry. Die doel van die proef was om te bepaal watter uitwerking onder die toestande van die Westelike Provinsie die onderstaande maniere van snoei op die groei- en drakrag van die behandelde bome sou hê

1. Kort-snoei.
2. Kort-snoei met 'n ligte somer-snoei behandeling.
3. Matig-snoei.

Alhoewel die proewe nie finaal afgehandel is nie, is belangrike resultate betreffende die beste sisteem van snoei vir bome in hul eerste groei- en drajare verkry. Die skrywer is van mening dat die resultate ook tot nut van boere sal wees, en daarom het hy dit goedgedink om hierdie voorlopige mededeling te publiseer. Die resultate met appelkose word nie ingesluit nie, maar stem in hoofsaak ooreen met dié van Santa Rosapruime.

Santa Rosa-pruime.

Doeltreffende bome wat pas geplant was, was nie vir die proefneming met pruime beskikbaar nie; gevolglik is gebruik gemaak van bome wat reeds 'n paar jaar in die boord gevestig is.

TABEL 2.—SANTA ROSA-PRUIME. STAMDIKTEMETINGS IN SENTIMETERS. 1922—1927.

	Vak. I. (Kortsnoei)						Vak II. (Kortsnoei plus Somersnoei)						Vak III. (Matigsnoei)					
Boom No.	1922	1923	1924	1925	1926	1927	1922	1923	1924	1925	1926	1927	1922	1923	1924	1925	1926	1927
1	—	—	—	—	—	—	2·87	4·95	5·8	—	7·67	8·21	2·97	4·65	5·3	6·4	7·12	8·625
2	—	—	—	—	—	—	2·85	4·80	5·6	—	9·05	10·72	3·03	4·41	5·6	6·9	8·10	9·51
3	—	—	—	—	—	—	4·66	6·11	7·6	—	9·25	10·07	2·82	4·89	6·4	7·6	9·19	11·0
4	—	—	—	—	—	—	—	—	—	—	—	—	4·50	6·99	8·5	9·30	10·40	11·40
5	—	—	—	—	—	—	2·25	3·66	4·5	—	8·35	9·35	—	—	—	—	—	—
6	4·18	6·35	6·8	—	8·075	9·20	4·03	6·11	7·4	—	9·51	10·04	5·23	7·16	8·6	9·7	10·875	12·35
7	4·19	6·61	7·7	8·7	9·54	9·75	3·87	5·74	7·5	8·9	9·97	11·05	4·88	7·74	9·4	11·5	12·49	14·8
8	4·63	6·18	7·4	8·7	9·51	10·39	5·47	7·65	8·8	9·5	10·2	11·125	4·58	6·75	8·55	10·2	11·52	13·31
9	5·46	7·45	8·4	9·7	9·72	10·40	4·67	6·30	8·0	8·7	9·8	11·52	3·64	5·58	6·66	8·2	9·15	9·62
10	3;8	4·90	6·0	—	9·82	7·925	4·23	5·73	7·35	8·4	8·85	9·67	5·64	8·23	10·0	11·75	12·5	14·09
11	4·31	6·21	7·3	9·2	10·01	11·60	4·25	5·65	7·1	8·4	9·12	10·39	3·45	5·30	6·6	8·4	9·5	10·12
12	4·46	5·73	7·2	8·4	9·125	10·40	4·23	6·02	7·3	8·2	9·0	10·30	4·57	6·64	8·6	9·5	10·8	11·35
13	5·32	7·70	8·85	9·5	10·01	11·02	3·45	4·54	6·5	6·65	6·79	8·60	4·40	6·10	7·2	8·9	10·0	10·30
14	4·37	5·81	7·4	9·7	9·51	9·72	4·92	6·37	8·1	9·7	10·20	10·87	4·24	6·51	8·5	9·7	11·55	12·01
15	5·14	5·82	8·3	10·45	11·175	11·95	4·17	5·60	7·45	8·7	9·35	10·02	4·56	6·89	8·5	11·2	12·61	14·10
16	4·48	6·60	7·9	8·7	10·00	11·025	5·21	6·45	8·1	9·95	11·57	14·20	5·45	8·30	11·7	12·7	14·70	14·85
17	3·12	4·91	5·9	7·6	8·50	9·11	3·29	4·95	7·1	8·4	9·51	10·85	5·26	7·24	8·5	11·0	12·80	14·10
18	4·09	5·88	7·4	8·2	9·40	9·97	6·01	7·94	10·0	11·5	12·85	13·55	3·75	5·66	7·2	8·15	9·625	10·40
19	6·13	8·47	10·3	—	13·59	14·45	4·38	6·11	7·85	9·2	10·01	10·40	4·64	6·68	7·8	9·7	10·70	11·175
20	5·95	7·78	9·3	12·45	12·00	12·85	5·09	6·86	7·0	8·2	11·12	11·95	4·90	7·14	9·0	10·7	12·175	13·55
21	5·03	6·21	7·0	8·2	9·87	10·40	3·36	3·84	5·0	6·15	6·67	7·60	5·23	7·38	9·5	11·0	12·17	13·00
22	5·48	7·43	8·8	8·9	11·40	12·72	5·05	6·53	8·3	9·7	11·01	11·80	3·94	6·44	8·1	9·8	10·89	11·65
23	5·58	7·36	8·8	11·0	11·50	12·5	4·71	6·15	7·6	9·2	10·35	10·70	5·18	7·35	8·7	10·2	11·54	12·95
24	5·94	7·25	8·25	10·45	12·41	12·7	4·98	6·45	7·8	9·7	10·7	12·49	4·99	7·43	9·1	11·0	12·41	13·80
25	4·81	6·51	7·8	9·7	9·97	10·70	3·74	5·34	6·3	7·4	8·62	9·40	4·44	6·10	7·2	8·7	9·70	10·70
26	3·6	6·65	8·5	9·95	11·05	12·47	4·44	6·38	8·1	9·2	10·39	11·175	4·82	6·70	7·7	9·5	11·25	12·80
27	4·61	6·79	8·4	9·7	10·69	11·6	5·09	6·52	7·5	8·7	9·51	10·95	3·52	5·63	7·3	8·9	10·20	10·67
28	—	—	—	—	—	—	4·80	6·38	7·9	8·9	9·15	9·70	4·12	5·94	7·1	7·9	8·80	9·80
	4·758	6·572	7·895	9·43	10·31	11·03	4·298	5·893	7·316	8·788	9·576	10·62	4·398	6·51	8·044	9·574	10·84	12·88
Gem Stamdikte	±·1127	±·1276	±·1459	±·1723	±·1829	±·2151	±·1095	±·1255	±·1460	±·1589	±·1733	±·1851	±·0997	±·1296	±·1754	±·1936	±·2118	± ·2218
% Gem. Toeneem van stamdikte op vorige jaar	—	38·12	20·13	19·86	8·95	7·06	—	37·11	24·14	20·12	8·96	10·48	—	48·021	23·56	19·02	13·22	9·59
% Gem. Toeneem van stamdikte op 1922	—	38·12	65·93	98·19	116·68	131·82	—	37·11	70·22	104·46	120·47	143·83	—	48·021	82·90	117·68	146·47	170·41
						±3·068%						±3·078%						2·478

Hierdie bome is in 1919 geplant, en by die plant kort geknip tot op 'n hoogte van omtrent 20 duim, soos aanbeveel word om die oopsenter- of ,,vase-vorm''-fatsoen te verkry. Gedurende die volgende winters (1920 en 1921) is alle bome betreklik kort geknip. Die proefneming is in 1922 begin, en nadat die stamdiktes noukeurig gemeet is, is die volgende snoeibehandelings toegepas :—

Vak I.—Kortsnoei, d.w.s. oortollige langlote en kortlote is verwyder, en van die oorblywendes is minstens tweederdes van die vorige jaar se lengtegroei van langlote en drie-kwart van die lengtegroei van kortlote afgeknip.

Hierdie sisteem kom ooreen met die algemene kortsnoei-praktyk in die Westelike Provinsie vir bome van dié ouderdom.

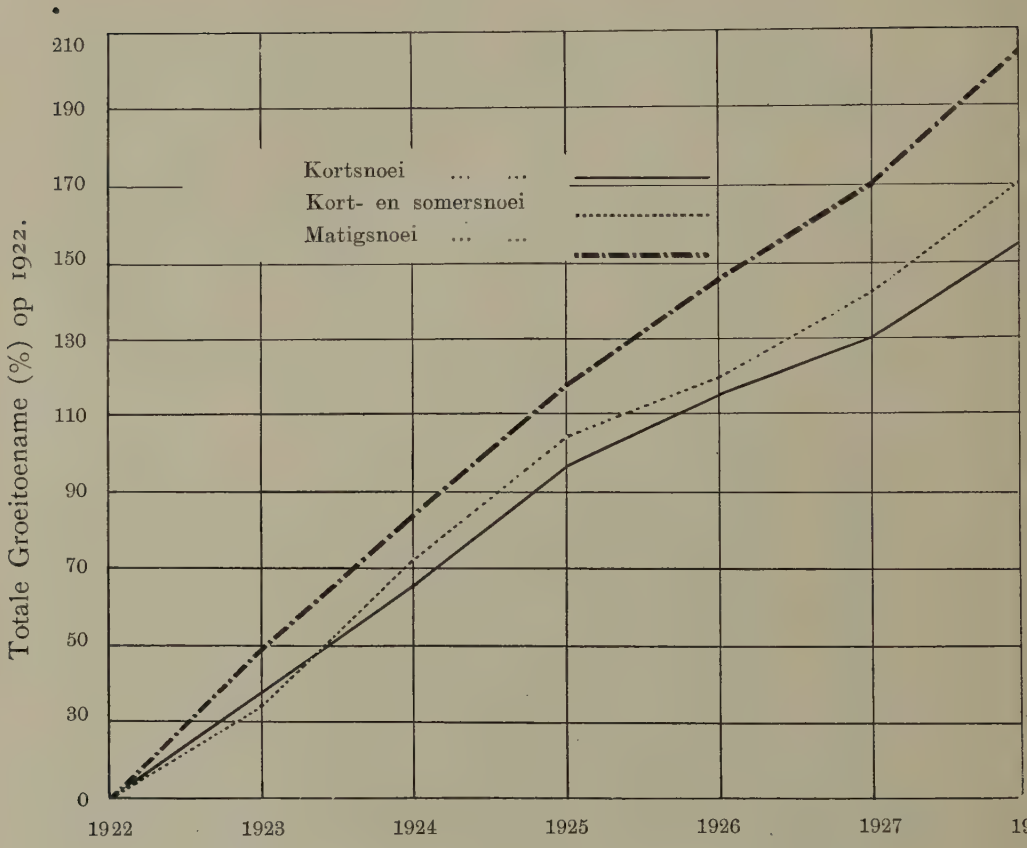
Vak II.—Gesnoei soos Vak I, maar verder nog in laat somer gesnoei—ongeveer end Februarie of begin Maart. Hierdie somersnoei het bestaan uit die uitdun (liggies) van oortollige lote waar die lote te dig was.

Vak III.—Matig-snoei, d.w.s. meer raamtakke en kortlote is toegelaat en nie meer as een-derde van die lengtegroei van lang- en kortlote is afgesny nie. Met ander woorde, die vorm van die boom is gekontroleer met 'n mienimum mate van snoei.

Die diktes van die boomstamme is gemeet by die aanvang van die proef, en die daaropvolgende jare, soos in Tabel 2 aangegee word.

Uit Tabel 2 sal opgemerk word dat in 1922 die gemiddelde stamdikte per boom van Vak I, 4.758 c.m. ± .1127; van Vak II, 4.2 ± .1095; van Vak III, 4.398 ± .0997 was; en dat hierdie gemiddelde stamdiktes in 1927 op 'n persentasie toename basis te staan kom op 131.82 ± 3.068 %, 143.83 ± 3.078 % en 170.12 ± 2.478 % respektiewelik. Dus aan die end van vyf jaar is die stamme van bome in Vak III duidelik dikker as die stamme van bome in die ander vakke. (Verskil tussen Vakke I en III ten gunste van Vak III : 38.30 ± 3.944 %.) (Sien Fig. 1.)

GRAFIESE VOORSTELLING, FIG. 1.



Santa Rosa-pruime: Grafiese voorstelling van totale groeitoename (%) op 1922.

Tufts het bewys deur stamdiktes van omtrent 200 bome van elk van die volgende bome, nl. amandels, okkerneute en perskes te meet, en die bome later sorgvuldig op te grawe en te weeg, dat daar 'n noue mate van korrelasie bestaan tussen stamdikte en die grootte of gewig van 'n boom. Dit is dus moontlik om die groottes van verskillende bome te vergelyk deur die diktes van hul stamme te meet.

In vergelyking met die resultate wat in Tabel 2 verkry is, toon die portrette in Figure 3, 4, 5 en 6 die verskille in voorkome aan van bome in Vakke I en III respektiewelik. Figure 3 en 4 is bome wat kort gesnoei is, Figure 5 en 6 bome wat matig- of liggesnoei is. Dit is duidelik sigbaar dat die bome wat 'n mienimum van snoei toegedaan is, verreweg die grootste en mooiste bome is. Hulle het blykbaar groot wortelsisteme ontwikkel, gepaard met groot, sterk, goedvertakte raamtakke, dus voorsien van 'n groot dra-oppervlakte. Hierdie resultate kom ooreen met die bevindings van navorsers in ander lande, nl. dat enige snoei van 'n jong nie-draende boom die groei van so 'n boom strem.

In Fig. II word die jaarlikse toename van stamdikte op die vorige jaar aangegee, en ons sien dat Vak III in 1923 48.021% aantoon, en dat hierdie persentasie verreweg die grootste groeitoename is wat in daardie jaar gemaak is. (Vergelyk met 38.12% en 37.11% van Vakke I en II respektiewelik.)

Om verdere gegewens oor die invloed van snoei op die gehele boom, maar spesiaal op die ontwikkeling van sy wortelsisteem te verkry, is 'n tiepiese boom uit elke vak sorgvuldig uitgegrawe en die wortelstelsel geweeg. Vir die doel is bome verkies wat in 1922 ongeveer ewe dik was. 'n Aantal bome is gesnoei, die snoeisels geweeg, en om 'n beraming te maak van die hoeveelheid hout gedurende die eksperiment afgeknip, is die gemiddelde syfer per vak per jaar vermenigvuldig by sewe. Tabel 3 gee die besonderhede aan, en toon groot verskille in die gewig van top en wortels ten gunste van die matiggesnoeide boom aan. (Sien Fig. 7.)

Tabel 3.—Besonderhede van die Gewigte van Bome uit Vakke I, II en III.

Vak No.	Dikte van boom in 1922 (s.m.)	Dikte van boom in 1928 (s.m.)	Gewig van Wortelsisteem (pond)	Gewig van top (pond)	Beraamde gewig van snoeisels oor 'n 7-jr. periode (pond)	Totaal (pond)
I.	4·37	9·72	31	60	38½	129½
II.	4·38	10·40	37½	80	43¾	161¼
III.	4·57	11·32	63	135	35⅞	233⅞

Fig. 7.—Wortelsisteme van Santa Rosa-pruimbome.
A—Matiggesnoei (Vak III).
B—Kortgesnoei (Vak I).

Oes-syfers.

Die vraag word gestel: „Wat van die oes?" Sommige boere, en veral die voorstaanders van kortsnoei, beweer dat die kortgesnoeide bome tog die voordeligste sal wees omdat hul groot vrugte sal oplewer, terwyl die matiggesnoeide klein vrugte sal produseer. Om hierdie vraag te antwoord, is die opbrengs van elke vak jaarliks sorgvuldig getel en in vier klasse gerangskik, volgens grootte.

Klas 1 sluit in alle pruime wat 'n diameter het van meer as $1\frac{7}{8}$ duim.
Klas 2 sluit in alle pruime wat 'n diameter het van $1\frac{3}{4}$ tot $1\frac{7}{8}$ duim.
Klas 3 sluit in alle pruime wat 'n diameter het van $1\frac{5}{8}$ tot $1\frac{3}{4}$ duim.
Klas 4 sluit in alle pruime wat 'n diameter het van onder $1\frac{5}{8}$ duim.

TABEL 5.—SANTA ROSA-PRUIME. BESONDERHEDE OMTRENT DIE AANTAL EN GROOTTE VAN VRUGTE. 1923—1928. DIE OES GEGRADEER IN 4 KLASSE VOLGENS GROOTTE

Jaar	Vak I. (Kortsnoei—22 bome)								Vak II. (Kort	Somersnoei—27 bome)							Vak III. (Matigsnoei—27 bome)							
	Klas 1. Diameter van vrugte meer dan 1⅞"	Klas 2. Diameter van vrugte van 1¾"—1⅞"	Klas 3. Diameter van vrugte van 1⅝"—1¾"	Klas 4. Diameter van vrugte onder 1⅝".	Totaal—alle klasse.	Totaal oes per akker van 100 bome	Persentasie van totale oes van alle vakke	Gemiddelde opbrengs per akker per jaar	Klas 1. Diameter van vrugte meer dan 1⅞"	Klas 2. Diameter van vrugte van 1¾"—1⅞"	Klas 3. Diameter van vrugte van 1⅝"—1¾"	Klas 4. Diameter van vrugte onder 1⅝"	Totaal—alle klasse	Totaal oes per akker van 100 bome.	Persentasie van totale oes van alle vakke	Gemiddelde opbrengs per akker per jaar	Klas 1. Diameter van vrugte meer dan 1⅞"	Klas 2. Diameter van vrugte van 1¾"—1⅞"	Klas 3. Diameter van vrugte van 1⅝"—1¾"	Klas 4. Diameter van vrugte onder 1⅝"	Totaal alle klasse	Totaal oes per akker van 100 bome	Persentasie van totale oes van alle vakke	Gemiddelde opbrengs per akker per jaar
1923 ...	0	38	66	264	368	1,673	34·33	—	4	20	43	135	202	748	15·35	—	0	6	52	604	662	2,451	50·30	—
1924 ...	356	233	210	131	930	4,227	38·95	—	377	173	150	55	755	2,796	25·76	—	402	292	205	135	1,034	3,829	35·28	—
1925 ...	145	72	51	39	307	1,395	25·93	—	158	39	54	34	285	1,055	19·62	—	247	130	246	168	791	2,929	54·45	—
1926 ...	214	227	369	147	957	4,350	22·02	—	171	146	377	75	769	2,848	14·42	—	410	760	1,442	777	3,389	12,791	63·55	—
1927 ...	424	798	3,835	4,256	9,313	42,331	25·65	—	490	1,251	4,836	4,752	11,329	41,959	25·43	—	218	956	5,965	14,652	21,791	80,707	48·81	—
1928 ...	332	949	2,080	1,802	5,164	23,468	24·30	—	372	1,175	2,587	2,266	6,400	23,703	24·55	—	619	2,049	4,754	5,910	13,332	49,387	51·14	—
Totaal ...	1,471	2,317	6,611	6,375	17,038	77,444	25·60	12,907	1,572	2,804	8,047	7,317	19,740	73,109	24·10	12,184	1,896	4,193	12,664	22,246	40,999	151,844	50·18	5·07
Totaal van klasse 1 en 2 per akker ...		17,218								16,207								22,551						

Gedurende November is die oes van die bome jaarliks uitgedun, en soos Tabel 4 aanwys, is meer as tweemaal soveel vrugte verkry van Vak III as van Vakke I en II saam. Gegewens vir die jare 1923 en 1924 is nie beskikbaar nie.

TABEL 4.—SANTA ROSA-PRUIME. GEWIGTE VAN UITGEDUNDE VRUGTE (pond).

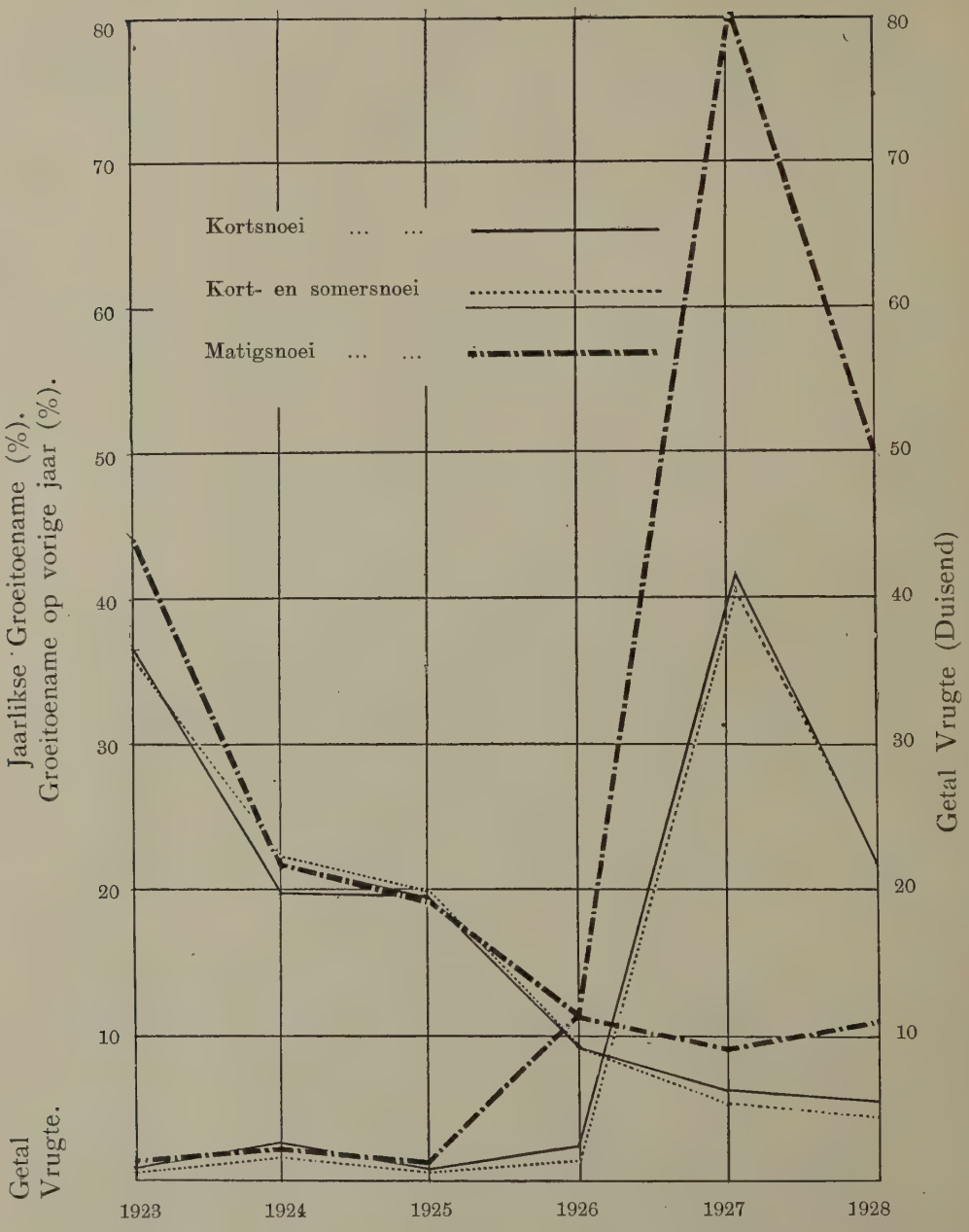
Datum.	Vak I. per 23 bome	Per akker	Vak II. per 27 bome	Per akker	Vak III. per 27 bome	Per akker
12.11.25 ...	23½	—	21	—	126	—
8.11.26 ...	112	—	124	—	418	—
4.11.27 ...	81¾	—	109¾	—	294¾	—
	117¼	533	254¾	944	838¾	3,106

Tabelle 4 en 5 toon dat Vak III (matigsnoei) verreweg die grootste hoeveelheid vrugte geproduseer het. Oor die ses-jaarperiode het hierdie vak meer vrugte gedra (50.60 %) as die ander twee vakke saam (25.60 % en 24.10 % van Vakke I en II respektiewelik). Die gemiddelde jaarlikse opbrengs per akker vir Vakke I, II en III, is 12,907, 12,184 en 25,307 respektiewelik—'n verbasende verskil ten gunste van bome wat 'n mienimum van snoei ontvang het.

Vak III het nie alleen die grootste aantal vrugte per akker gedra nie, maar ook die grootste aantal vrugte groter as 1¾ duim deursnit (Klasse 1 en 2 saam). Vergelyk 22,551 van Vak III met 17,218 van Vak I, en 16,207 van Vak II.

In die jaar 1923 is min vrugte gedra, en die bome in alle vakke het betreklik groot groei-vordering gemaak. In die daaropvolgende jare tot aan die jaar 1926, is die vrugte goed uitgedun, wat opgemerk word in die hoë aantal groot vrugte en die lae aantal klein vrugte. (Sien Tabel II.) Die eerste swaar drag is in 1927 gelewer, wat 'n geweldige groot uitwerking toon op die groeitoename, en gevolglik op die grootte van die bome. Klaarblyklik was die hoeveelheid vrugte uitgedun in November 1926, nie vir die boom met sy groot drag genoegsaam nie. 'n Meer doeltreffende uitdunning sou die aantal groot vrugte veral in Vak III

GRAFIESE VOORSTELLING, FIG. 2.



Santa Rosa-pruime: Grafiese voorstelling van die afneem van die groei namate die drag toeneem.

N.B.—Bome in Vak III (Matigsnoei) is in 1927 ook kort geknip, met die gevolg dat in 1928 'n klein vermeerdering in plaas van 'n vermindering op die vorige jaar se groei aangetoon word.

TABEL 6.—SANTA ROSA-PRUIME. DIE WAARDE IN DIE BOORD VAN DIE VRUGTE.

	Vak I. (Kortsnoei)					Vak II. (Kort + Somersnoei)					Vak III. (Matigsnoei)				
	Klas 1	Klas 2	Klas 3	Klas 4	Totaal	Klas 1	Klas 2	Klas 3	Klas 4	Totaal	Klas 1	Klas 2	Klas 3	Klas 4	Totaal
Oes per vak	1,471	2,317	6,611	6,375	—	1,572	2,804	8,047	7,317	—	1,896	4,193	12,664	22,246	
Oes per akker	6,668	10,532	30,050	28,977	—	5,822	10,385	29,803	27,100	—	7,022	15,529	46,903	83,392	
Getal gepakte kiste	148	210	500	414	—	129	207	496	387	—	156	310	781	1,177	
Verkoop waarde	£22 4 0	£26 5 0	£50 0 0	£31 1 0	£129 10 0	£19 7 0	£25 17 6	£49 12 0	£29 0 6	£123 17 0	£23 8 0	£38 15 0	£78 2 0	£88 5 6	£228 10 6
Waarde van vrugte per boom per jaar	—	—	—	—	4/4	—	—	—	—	4/1	—	—	—	—	7/4

Die gemiddelde jaarlikse waarde van die vrugte per boom vir die periode is dus van 3/- tot 3/3 meer in die geval van die matiggesnoeide boom.

TABEL 7.—BON CHRETIEN-PERE. STAMDIKTES (DIAMETER) IN SENTIMETERS. 1922—1927.

Boom No.	Vak I. (Kortsnoei)						Vak II. (Kort + Somersnoei)						Vak III. (Matigsnoei)					
	1922	1923	1924	1925	1926	1927	1922	1923	1924	1925	1926	1927	1922	1923	1924	1925	1926	1927
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	3·70	5·17	6·74	7·9	9·20	9·725	2·96	4·01	5·28	7·4	7·775	8·375	—	—	—	—	—	—
3	3·22	4·48	5·97	7·4	8·62	9·51	3·30	4·59	5·79	7·4	8·60	10·125	3·36	4·80	6·18	7·4	8·125	9·80
4	3·16	3·85	5·15	6·1	7·51	8·125	3·64	4·85	6·23	7·4	8·525	9·60	3·60	4·96	6·15	7·4	7·925	8·625
5	3·79	5·20	6·99	8·4	9·75	11·875	3·23	4·39	5·79	7·1	8·375	9·20	—	—	—	—	6·425	8·375
6	3·01	4·18	5·14	6·4	7·92	9·975	3·35	4·28	5·74	6·85	7·275	8·425	4·16	5·89	7·51	9·95	9·975	10·95
7	2·97	4·10	5·45	6·85	8·52	9·51	3·41	4·75	6·17	7·6	8·80	9·975	3·44	4·70	6·42	7·6	8·70	9·975
8	3·10	4·40	5·72	6·65	7·32	8·85	3·35	4·70	6·28	7·4	8·25	9·51	1·61	2·80	4·12	5·4	5·95	7·275
11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	2·84	4·38	5·57	6·4	7·80	8·85	3·01	4·30	5·36	6·65	7·625	8·85	—	—	—	—	—	—
13	3·63	4·85	5·94	7·1	8·37	10·125	3·03	4·30	5·64	6·85	8·10	9·45	2·76	3·80	4·35	5·7	6·25	7·00
14	3·51	4·99	6·97	8·9	10·85	13·20	3·82	5·02	6·86	8·70	10·025	11·53	4·15	5·77	7·12	9·2	10·85	12·35
15	3·30	4·70	6·23	8·4	9·80	10·40	3·31	4·47	6·34	7·60	8·80	9·975	3·45	5·07	7·25	8·9	10·95	12·60
16	4·14	4·53	6·84	9·7	10·95	12·70	2·85	4·00	5·39	6·85	8·10	9·00	3·96	5·45	6·39	8·2	9·975	11·525
17	3·41	4·68	6·04	7·4	7·62	8·825	3·43	4·55	5·78	6·85	7·925	8·85	3·22	4·78	5·76	7·1	8·125	8·85
18	2·50	3·51	4·34	5·4	6·20	7·175	3·47	4·50	5·64	6·65	7·625	8·85	4·08	5·18	6·85	7·9	9·125	10·05
Gemiddelde Stamdikte in s.m. ...	3·30 ±·0743	4·21 ±·1027	5·53 ±·1542	7·35 ±·2065	8·60 ±·2968	9·92 ±·2953	3·06 ±·0631	4·48 ±·0512	5·88 ±·0766	7·23 ±·0941	8·27 ·1184	9·40 ±·1435	3·43 ±·1450	4·83 ±·1711	6·19 ·2133	7·70 ±·2664	8·53 ±·3164	9·78 ±·3430
% Gem. toename op vorige jaar ...	—	27·5	31·3	32·9	17·0	15·3	—	36·17	31·2	22·9	14·3	13·6	—	43·7	28·1	24·4	10·8	14·9
% Gem. toename op 1922 ...	—	27·5	67·6	122·9	160·6	200·6 ±3·72%	—	36·17	78·1	119·7	151·0	185·7 ±2·55%	—	43·7	80·5	124·5	148·7	185·1 ±5·488%

vermeerder het, en gevolglik sou dit ook die aantal klein vrugte van die vak verminder het. Die gegewens gee bewyse dat namate die boom ouer word en meer dra, die groeikrag afneem (Tabel 4); dat die groeikrag besonder groot beïnvloed word deur 'n swaar oes, en dat matigsnoei vir Santa Rosa-pruime in hul eerste jare die beste snoeimetode is om sterk bome te verkry.

Vir die boer sal die verskille tussen die drie vakke miskien van meer belang wees, as hulle op 'n geldbasis voorgestel word. Tabel 6 gee die waarde van die vrugte *in die boord* op 'n akkerbasis van 100 bome, bereken teen :—

3/- per kis,	vir uitvoer gepak,	met 'n	inhoud	van	45 pruime.
2/6 per kis	...	...	...	...	50 pruime.
2/- per kis	...	...	...	...	60 pruime.
1/6 per kis	...	...	...	...	70 pruime.

Die pryse wat aangegee is, is arbitrer en mag te hoog of te laag wees vir sulke pruime vir uitvoer bedoel, maar is vir alle vakke dieselfde.

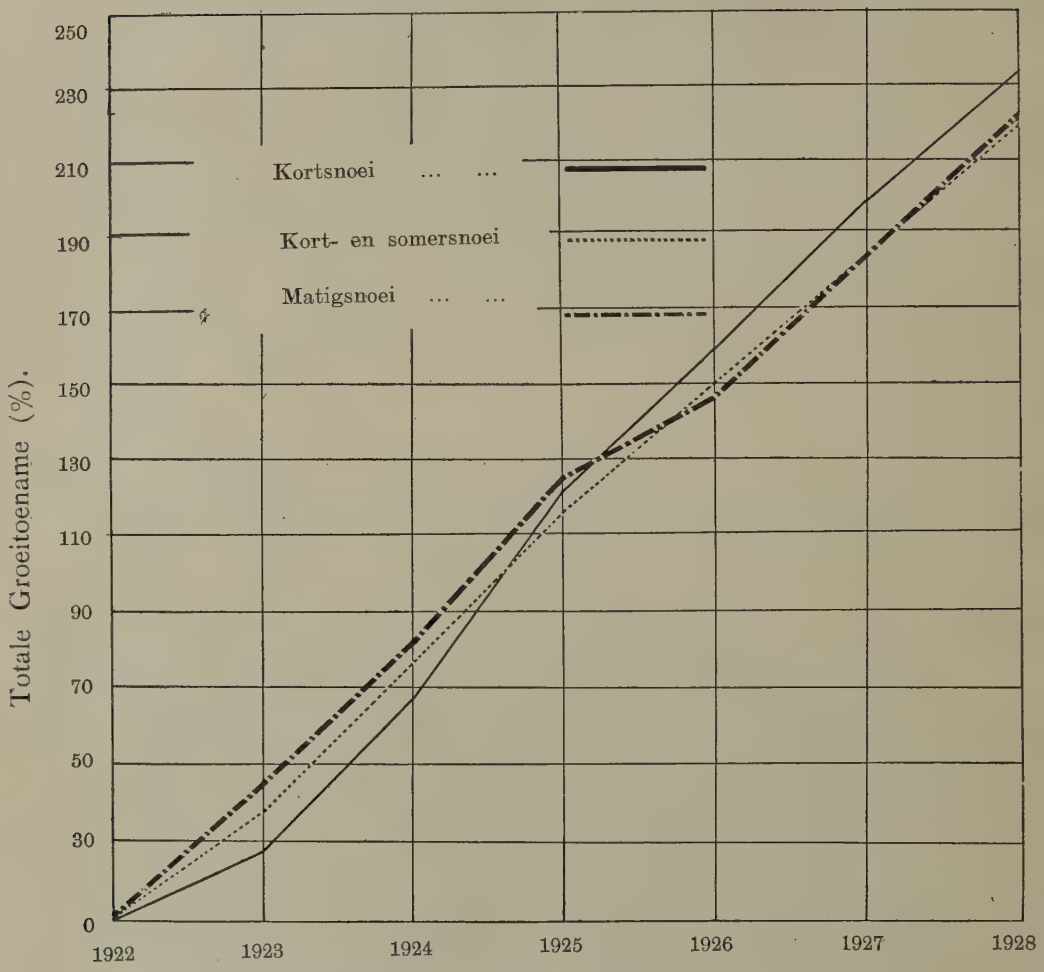
Pere.

Die snoeibehandeling wat aan Santa Rosa gegee is, is ook toegepas op Bon Chretien- en op Beurre Hardy-pere. Drie eweredig persele bome wat in 1921 geplant is en by die plant kortgeknip is, is uitgesoek, en in die daaropvolgende winter, is die verskillende sisteme van kortsnoei, kortsnoei met 'n somersnoeibehandeling, en matigsnoei toegedien. Die stamdiktes is gemeet en word in Tabel 7 uiteengesit.

Fig. 8, 'n grafiese voorstelling van die sesjarige groeitoename, toon dat geen groot verskille voorkom nie, en dat die bome in Vak III ten opsigte van groei-toename tot aan die end van 1925 die bome in ander vakke voor was.

Fig. 9 gee die verhouding van die drag vrugte tot die persentasie groei-toename; hier word getoon dat die bome in Vak III relatief groter groei-vordering gemaak het, en dat die groeikrag van die bome vinnig afneem namate die drag vrugte toeneem. Bome in Vak III het reeds in 1925 begin dra, maar die gegewens vir daardie jaar is nie beskikbaar nie.

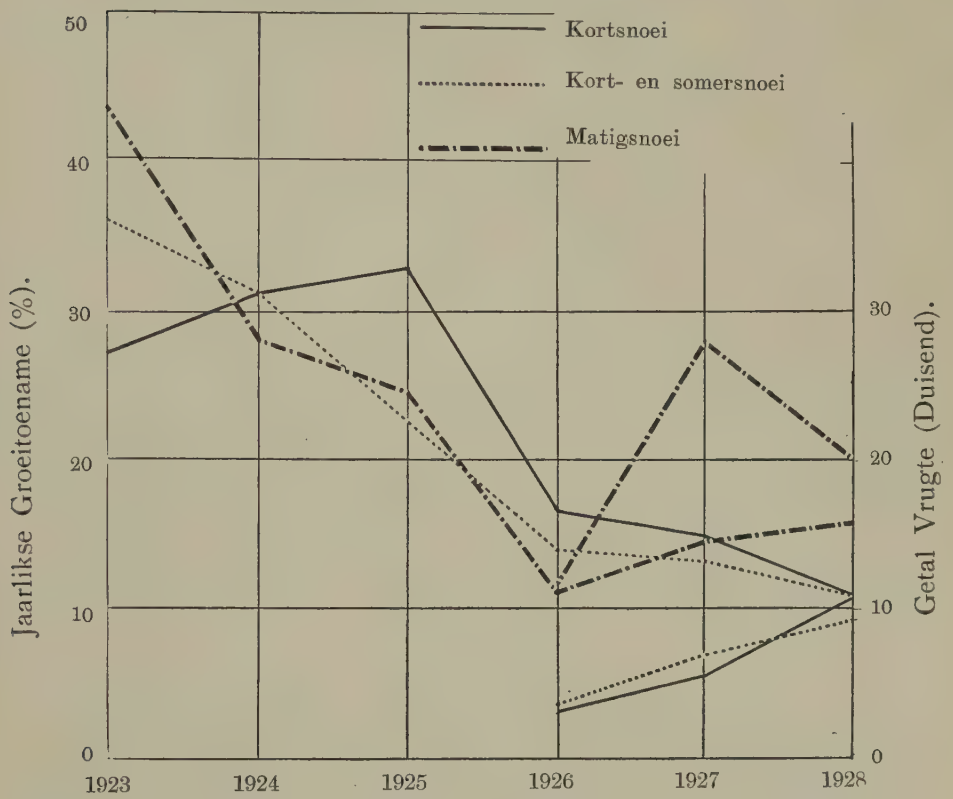
GRAFIESE VOORSTELLING, FIG. 8.



Bon Chretien-pere: Grafiese voorstelling van totale groeitoename (%) 1922—1928.

Die bome in Vak III het aanduidings gegee van te min groeikrag, wat toegeskryf word aan die uitwerking van die swaar oeste. In die winter van 1927 is hulle ook, soos die bome in die ander peer-vakke, kort gesnoei, met die gevolg dat hulle 'n vermeerdering in die gemiddelde diktes in die volgende jaar (1928) vertoon het. (Sien Fig. 9.)

GRAFIESE VOURSTELLING, FIG. 9.



Bon Chretien-pere: Grafiese voorstelling van die jaarlikse groeitoename en van die getal vrugte.

N.B.—Bome in Vak III (Matigsnoei) is in 1927 ook kort geknip, met die gevolg dat 'n vermeerdering van groei op die vorige jaar aangetoon word.

Die gevolgtrekking is dus ook in dié geval, dat matiggesnoeide bome voor hulle deur hul oes gestrem word, die grootste bome vorm, maar dat die verskille in groeikrag by die Bon Chretien nie so groot is as in die geval van die Santa Rosa-pruim nie. Die verskille egter in die oes is veel groter, soos aangetoon sal word.

DIE INVLOED VAN SNOEI OP DIE DRAG VAN BON CHRETIEN.

Die matiggesnoeide bome het in 1924 begin dra, maar gegewens vir 1924 en 1925 is nie beskikbaar nie. Vanaf 1926 is

data versamel van die oes van alle vakke. Die vrugte is noukeurig getel en in vier klasse gegradeer volgens hul deursnit-grootte.

In Klas 1 is pere gerangskik met 'n diameter van meer dan $2\frac{3}{4}$ duim.

In Klas 2 is pere gerangskik met 'n diameter van $2\frac{1}{2}$ tot $2\frac{3}{4}$ duim.

In Klas 3 is pere gerangskik met 'n diameter van $2\frac{1}{4}$ tot $2\frac{1}{2}$ duim.

In Klas 4 is pere gerangskik met 'n diameter van onder $2\frac{1}{4}$ duim. (Sien Tabel 8.)

Dit is merkwaardig dat die totale opbrengs per akker van Vak III vir die drie-jaar-periode, meer as dubbel die oes is van die ander twee vakke (vergelyk 20.65 %, 21.24 % en 57.99 % van Vakke I, II en III respektiewelik). Hierdie verhouding in die drag van die drie vakke is in 1928 kleiner, wat toegeskrywe word aan 'n stremmende effek op die bome van die swaar drag van Vak III gedurende die vorige twee jare. (Sien Tabel 8.)

Nie alleen 'n groter drag, maar ook meer groot vrugte is deur Vak III geproduseer (vergelyk 1,377, 1,390 en 2,699—die syfers vir Vakke I, II en III respektiewelik).

In Tabel 9 word die waarde van die vrugte van die verskillende vakke uiteengesit op 'n basis van 3s., 2s., 1s. en 9d. vir 'n gepakte kis van Klasse 1, 2, 3, 4 en 5 respektiewelik. Die geldwaarde kom te staan op £62 13s. 3d. per akker vir drie jaar vir Vak I, £64 1s. vir Vak II en £170 8s. 6d. vir Vak III, en die gemiddelde opbrengs per boom per jaar vir Vak I, is 4s. 2d.; 4s. 3d. vir Vak II, en 11s. 1d. vir Vak III—'n verskil dus van byna 7s. per boom ten gunste van die matiggesnoeide bome.

Beurre Hardy-pere.

Fig. 10 en 11 gee die grootte van Beurre Hardy-pere aan; Fig. 12 'n grafiese voorstelling van die sesjarige groei-toename, wat aandui dat die Beurre Hardy-bome van Vak III tot aan die einde van 1926 die bome in die ander vakke voor was; en Fig. 13 die jaarlikse groei-toename van die bome in die drie vakke.

(Die skommeling wat in 1924 in Vak III voorkom, kan nie verklaar word nie, en word aan 'n eksperimentele fout toegeskrywe.)

TABEL 8.—BON CHRETIEN-PERE. BESONDERHEDE VAN DIE AANTAL EN GROOTTE VAN DIE VRUGTE. 1926—1928.

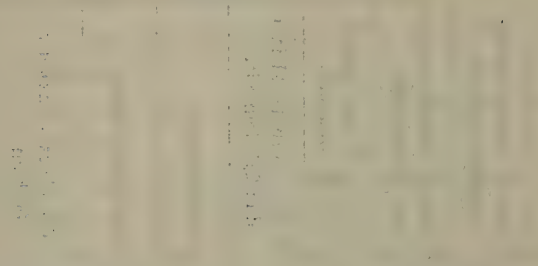
Pere verdeel in 4 klasse volgens grootte, met 'n vyfde klas vir vrugte wat van die grond opgetel is.

	Vak I. (Kortsnoei) Aantal Bome 14.								Vak II. (Kort + Somersnoei) Aantal Bome 14								Vak III. (Matigsnoei) Aantal Bome 11.							
	Klas 1. Vrugte groter dan 2¾" deursnit.	Klas 2. Vrugte van 2½ tot 2¾" deursnit.	Klas 3. Vrugte van 2¼ tot 2½" deursnit.	Klas 4. Vrugte kleiner dan 2¼" deursnit.	Optel vrugte.	Totaal alle klasse.	Totaal oes per akker van 100 bome	Persentasie van totale oes van alle vakke	Klas 1. Vrugte groter dan 2¾" deursnit	Klas 2. Vrugte van 2½ tot 2¾" deursnit	Klas 3. Vrugte van 2¼ tot 2½" deursnit.	Klas 4. Vrugte kleiner dan 2¼" deursnit	Optel vrugte	Totaal alle klasse	Totaal oes per akker van 100 bome	Persentasie van totale oes van alle vakke	Klas 1. Vrugte groter dan 2¾" deursnit	Klas 2. Vrugte van 2½ tot 2¾" deursnit	Klas 3. Vrugte van 2¼ tot 2½" deursnit	Klas 4. Vrugte onder 2¼" deursnit	Optel vrugte	Totaal alle klasse	Oes per akker	Persentasie van totale oes van alle vakke
1926	96	131	77	47	76	427	3,050	17·34	111	153	106	59	48	477	3,407	19·39	317	272	259	111	264	1,223	11,118	63·26
1927	155	130	355	62	65	747	5,335	12·97	207	210	330	135	126	1,008	7,200	17·50	322	625	1,165	635	399	3,146	28,600	69·52
1928	137	728	497	139	—	1,551	11,078	27·12	91	618	484	138	—	1,331	9,507	23·28	116	1,047	802	263	—	2,228	20,254	49·60
Totaal	388	989	909	298	141	2,725	19,463	20·65	409	981	920	332	174	2,816	20,114	21·24	755	1,944	2,226	1,009	663	6,597	54,640	57·99
Klasse 1 en 2 Totaal	1,377								1,390								2,699							

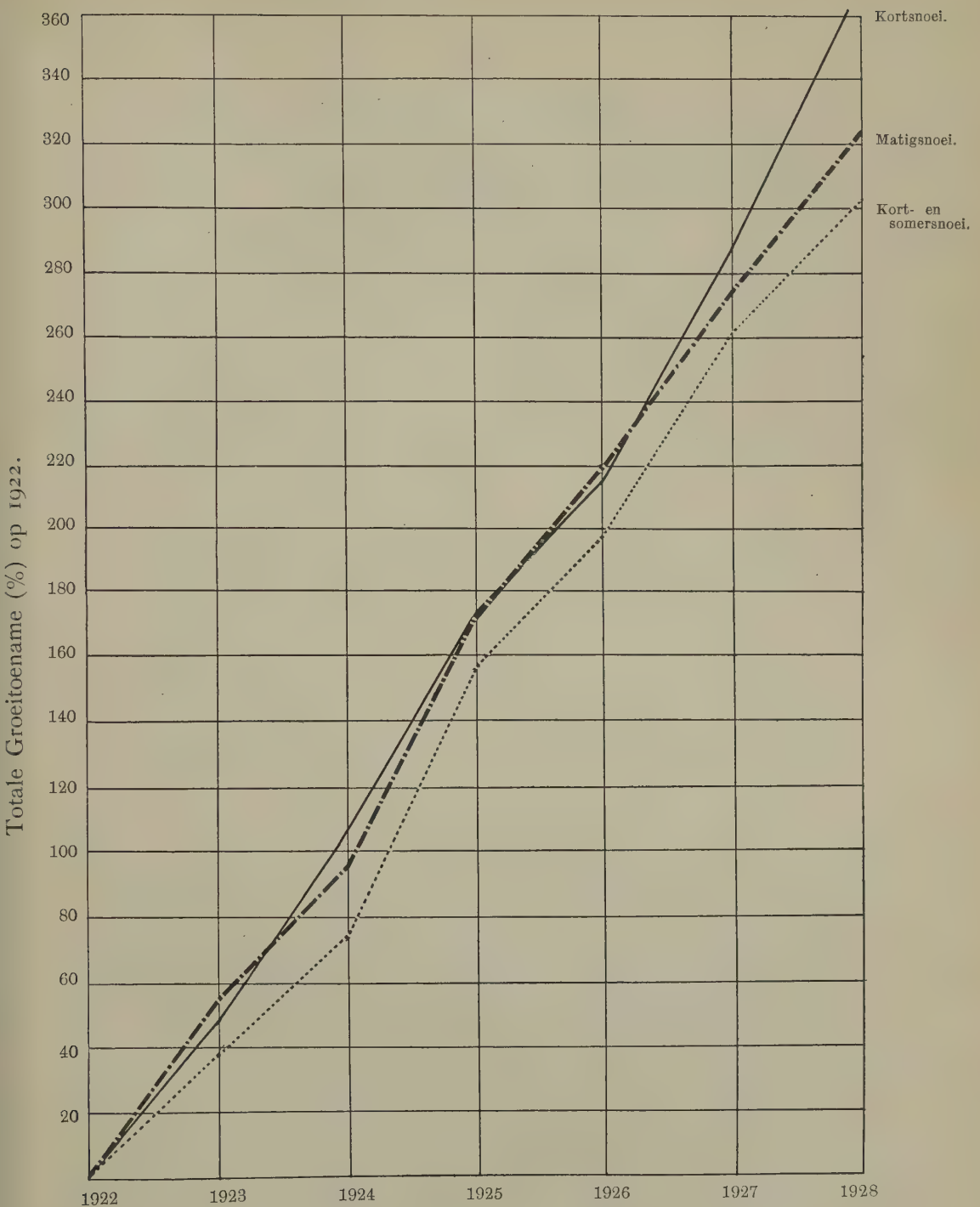
TABEL 9.—BON CHRETIEN-PERE.

Die waarde van die vrugte van die 3 snoeivakke gereken op 'n basis van: 3s. per kis van Klas 1 (21 pere per kis); 2s. per kis van Klas 2 (25 pere per kis); 1s. per kis van Klas 3 (28 pere per kis); 9d. per kis van Klas 4 (36 pere per kis).

	Vak I. (Kortsnoei) (14 bome)					Vak II. (Kort × Somernoei) (14 bome)					Vak III. (Matigsnoei) (11 bome)				
	Klas 1	Klas 2	Klas 3	Klasse 4 en 5	Totaal	Klas 1	Klas 2	Klas 3	Klasse 4 en 5	Totaal	Klas 1	Klas 2	Klas 3	Klasse 4 en 5	Totaal
Opbrengs 1926, 1927, 1928 ...	388	989	909	439	—	409	981	920	506	—	755	1,944	2,226	1,672	—
Opbrengs per akker ...	2,771	7,064	6,492	3,135	—	2,921	7,007	6,571	3,614	—	6,863	17,672	20,236	15,200	—
Getal kiste per akker ...	141	282	231	87	—	139	280	234	100	—	326	706	722	422	—
Waarde per klas	£19 13 0	£28 4 0	£11 11 0	£3 5 3	£62 13 3	£20 17 0	£28 0 0	£11 14 0	£3 15 0	£64 1 0	£48 18 0	£70 12 0	£36 2 0	£15 16 6	£171 6
Gemiddelde opbrengs per boom per jaar	—	—	—	—	4/2	—	—	—	—	4/3	—	—	—	—	11/5

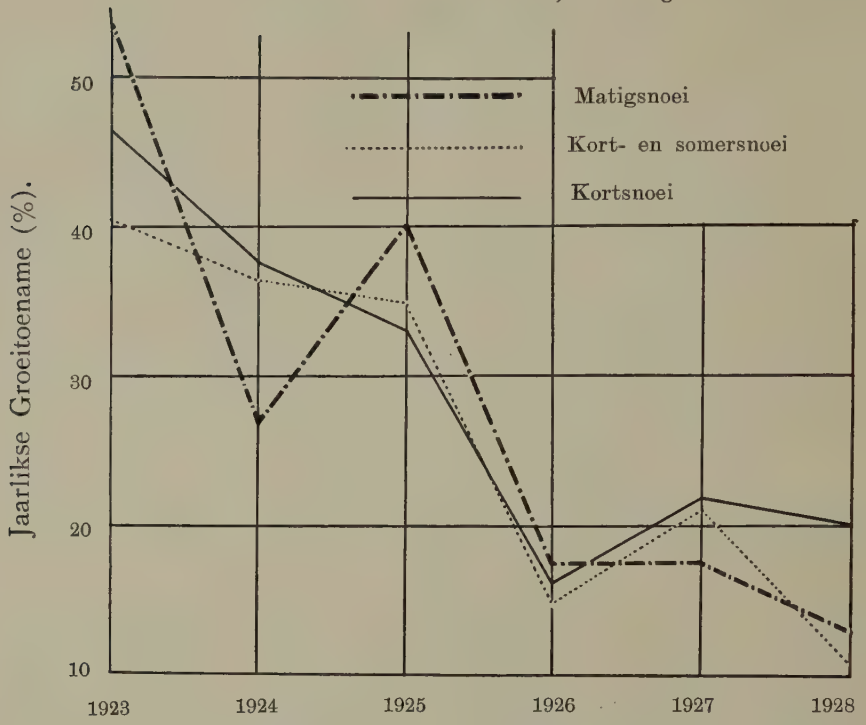


GRAFIESE VOORSTELLING, FIG. 12.



Beurre Hardy-pere: Grafiese voorstelling van totale groeitoename (%) op 1922.

GRAFIESE VOORSTELLING, FIG. 13.



Beurre Hardy-pere: Grafiese voorstelling van die jaarlikse groeitoename (%).

GEVOLGTREKKINGS.

Snoei-invloed op groei- en drakrag. Dat sekere oë geprikkel word deur snoei, is algemeen bekend; maar wat die oorsaak is van die prikkeling, kan nie met soveel sekerheid gesê word nie. Reed is geneig om te verklaar dat deur snoei, een of ander stof wat 'n stuitende invloed het op die groei, verwyder word. Dit kan ook wees dat as gevolg van snoei, 'n groei-prikkelende stof ontwikkel word; maar voldoende bewyse is vir sulke teorieë nie aangebring nie.

Ons kan aanneem dat enige soort snoei op 'n jong niedraende boom, tot 'n groter of kleiner mate 'n stremmende uitwerking op die boom as geheel sal hê, afhangende van die

soort van boom wat gesnoei word. Selfs in die geval wanneer die boom se groei deur snoei skynbaar verbeter is, word die verskynsel toegeskryf aan die feit dat die boom kleiner gemaak word met 'n kleiner aantal groeipunte. Die minerale voedingstowwe en veral die watervoorraad wat deur die wortelsisteem opgeneem word, is tydelik tot 'n groter mate ter beskikking van die groeipunte wat oorbly. Die wortelsisteem word nie dadelik beïnvloed deur die snoei van die toppe nie, en dus word die voorraad water en voedingstowwe per groeipunt groter. Ons kan dus die groeitoename wat onder gewone toestande op snoei volg, in alle waarskynlikheid toeskrywe aan 'n groter watervoorraad as gevolg van 'n verminderde blaaroppervlakte, terwyl die absorberende wortelsisteem, vir 'n tyd in elk geval, nie beïnvloed word nie.

As gevolg van snoei, is daar minder blare; daar die blaar die orgaan is waar plantvoedsel opgebou word vir die plant, volg dit dat daar dan ook minder opgeboude plantvoedsel is. 'n Ander uitwerking van snoei, is dat besondere gunstige groeitoestande geskep word na aan die snoeiplek. As gevolg van 'n oormaat water en plantvoedsel deur die wortels opgeneem, vind groei veral hier plaas ten koste van die wortelsisteem. Op hierdie wyse word die dwergende uitwerking op die wortelsisteem verklaar, en omdat die boom tot 'n groot mate vir sy groei en drag afhanklik is van sy wortelsisteem, gee dit ook die verklaring waarom 'n boom deur snoei verklein word.

Enige boom het 'n vegetatiewe periode wanneer sterk groei plaasvind, gevolg deur 'n oorgangstadium waar groei afneem namate die drag toeneem, en uiteindelik kom die draperiode waar drakrag die oorhand kry, en die gewone tekens van groei nie so duidelik sigbaar is nie.

'n Gesnoeide boom word geprikkel om hierdie vegetatiewe periode te verleng, met die gevolg dat die drastadium vertraag word.

Die Invloed van Somersnoei.

Die gegewens wat verkry is as resultaat van somersnoeibehandeling, word in Tabel 10 aangegee.

TABEL 10.*

Die Invloed van Somersnoei op die Groeikrag van Peer- en Pruimbome. 1922—1927.

	Vak I (Wintersnoei). Gem. groei-toename op 1922. %	Vak II (Winter- en Somersnoei). Gem. groei-toename op 1922. %	Wins deur Somergesnoeide bome. %
Santa Rosa Pruim	131.82 ± 3.068	143.83 ± 3.078	12.01 ± 4.34
Bon Chretien-peer	200.6 ± 3.72	185.7 ± 2.55	14.9 ± 4.514
Beurre Hardy-peer	286.4 ± 9.98	261.2 ± 2.86	23.4 ± 10.39

In die geval van albei peervarieteite word 'n verlies van groeikrag aangeteken, en bewyse word in bostaande tabel gelewer dat die toediening van addisionele snoei in die vorm van 'n ligte uitdunning van langlote in die laat somer die groeikrag van bome strem. Santa Rosa-pruime, inteendeel, gee 'n klein verskil ten gunste van somersnoei. Hier moet egter in aanmerking geneem word dat 'n groter hoeveelheid vrugte van die somergesnoeide pruimbome uitgedun is (sien Tabel 4), wat 'n groter groei-toename in verhouding met Vak I sal veroorsaak. Die verskil by die pruimbome tussen Vakke I en II, is 12.01 ± 4.34%; weens die grootte van die waarskynlike fout, kan selfs hierdie wins nie van betekenis ten gunste van hierdie soort somersnoei beskou word nie.

Blykens het die somersnoei 'n groter groeistremmende invloed op peerbome dan op pruimbome gehad, wat 'n aanduiding is dat die groei wat in die laat somer plaasvind, 'n groter rol in die ekonomie van die boom speel by die peer- as by die pruimboom.

Ten spyte van die algemene mening onder vrugteboere, en die toepassing van hierdie soort somersnoei wat so dikwels in die praktyk getref wôrd, openbaar die somersnoei van bome, ook

* Vir die uitwerk van statistiese data in Tabelle 2, 7 en 10, is ek dank verskuldig aan assistente A. de Wet en I. Burger.

wat oes betref, geen voordeel nie. Volgens Tabel 6 word 'n verlies van 3d. per boom by Santa Rosa en by Bon Chretien 'n wins van 1d. per boom aangeteken. Beurre Hardy-peerbome het hul eerste oes in 1928 gelewer, en vergelykende oes-syfers oor 'n aantal jare is dus nie beskikbaar nie.

Opsomming.

Ons eksperimente toon aan dat :—

1. Die drastadium van kortgesnoeide bome aansienlik vertraag word as gevolg van die drastiese snoeibehandeling.

2. Ten spyte van swaar oeste wat oor 'n aantal jare gedra is, matiggesnoeide Santa Rosa-bome groter dan kortgesnoeide bome is. Dat dus die gebruiklike manier van kortsnoei om mooi simmetriese bome te verkry, 'n groter stremmende invloed op die bome uitgeoefen het dan groot oeste op matiggesnoeide bome.

3. Klein verskille te sien is ten gunste van matiggesnoeide bome tot op die stadium wanneer die bome begin dra, maar dat die verskille in die grootte van bome as gevolg van snoei by Bon Chretien, en ook in die geval van Beurre Hardy-pere, nie tot dieselfde mate sigbaar is as in die geval van die pruim nie. Blykbaar word die peerboom met ons lang groeiseisoen aangemoedig deur snoei om sy groeiseisoen te verleng, en om die proses van fotosintese in dié tyd so te prikkel dat die jaarlikse groei-toename nie tot groot mate benadeel word nie.

4. Matiggesnoeide bome meer vrugte, en ook meer groot vrugte per boom dra, mits die drag van die bome in vroeë somer uitgepluk word; en gevolglik dat die voorgeskrewe behandeling vir die boer die voordeligste snoeimetode is.

5. Terwyl die bewyse daar is dat snoei die groeikrag van 'n boom strem, die bewyse meer in die ooglopend is, veral met Bon Chretien-pere, dat 'n groot oes op die groeikrag 'n groter stremmende uitwerking het.

6. Die toediening van somersnoei soos toegepas, 'n groeiswakkende uitwerking het, en dat die praktyk uit 'n ekonomiese standpunt nòg tydelik nòg op die duur enige voordeel besit.

Ons resultate oor die invloed van snoei op die drakrag van vrugtebome, verkry in die suidelike halfrond onder omstandighede waar winter-reënval gepaard gaan met 'n lang droë seisoen, kom in hoofsaak ooreen met die werk van navorsers in Europa en in Noord-Amerika. In Engeland het Grubb met appelbome gewerk en gevind dat die inkort van langlote die aantal blomoë verminder, en dat die drastadium van die boom vertraag word. In Amerika was Alderman en Auchter se ondervinding dat min snoei die drastadium van bome vervroeg, terwyl Tufts ook gevind het met die meeste soorte vrugtebome wat in Kalifornië gekweek word, dat die drastadium vir 'n aantal jare uitgestel word. Chandler het dieselfde proewe gemaak met appel-, peer-, pruim- en kersiebome oor 'n periode van ses tot tien jaar, en sy resultate toon aan dat matiggesnoeide bome van alle varieteite meer vrugte gedra het.

Aanbevelings.

Om vaste snoeireëls neer te lê, is 'n uiters moeilike saak. 'n Geoefende snoeier weet dat elke vrugteboom sy eie behandeling nodig het. Die soort vrugte en die varieteit, die ouderdom en die groeikrag moet in aanmerking geneem word, en dikwels moet die praktyk gewysig word om by plaaslike toestande aan te pas.

As gevolg van ons proefneming, kan sekere prinsiepes as 'n leidraad vir boere neergelê word, en die volgende aanbevelings vir algemene toepassing kan hier gemaak word.

A. *Vir jong, nie-draende Bome.* By die kweek van 'n boom in hierdie stadium, stel die boer hom ten doel :—

1. Om 'n boom te verkry met 'n sterk konstitusie voorsien met 'n goed ontwikkelde raam wat groot oeste in later jare sal kan dra.

2. Om so gou moontlik 'n boom te produseer groot genoeg om oeste van vrugte van goeie grootte en goeie kleur te lewer, sonder dat die boom deur so 'n drag beskadig word.

Groot groeikrag is klaarblyklik vir die ekonomie van die boom in hierdie stadium essensieel. Onder normale omstandighede sal dit die taak van die boer wees om die groeikrag aan te moedig, veral waar sulks nodig is, terwyl die boom nog in sy vegetatiewe stadium verkeer. Groot oeste kan alleen gedra word op groot bome, en pogings moet gemaak word om hierdie groei van die bome in hul nie-draende stadium te prikkel.

Jong bome vorm in baie gevalle nie genoeg langlote nie, wat 'n aanduiding is van 'n tekort òf van water òf van plantvoedsel: Snoei is vir sulke bome nie genoeg nie; 'n mengsel van vrot stalmis en fosfaat is vir hulle vir die eerste aantal jare tot groter nut as die snoeiskêr. Bemesting, besproeiing, grondbewerking en die kontrole van swamme of van blaarvretende insekte, is faktore van groot belang in verband met die snoeivraagstuk, en moet veral aandag geniet as jong bome op die hierbo-beskryfde manier gesnoei word. In die algemeen word te veel van snoei verwag, en nie genoeg aandag word aan besproeiing, bemesting en goeie grondbewerking gegee nie. Hierdie faktore moedig groei aan, en speel dus 'n groot rol om goedgevormde sterk bome te verkry.

As die boom uit die kwekery gehaal word, bly 'n groot gedeelte van die wortelsisteem onvermydelik agter. Om die nodige balans of ewewig tussen die bogrondse gedeelte en die wortelsisteem te herstel, word kortknip van die raam ná die boom geplant is, aanbeveel.

In die daaropvolgende jare, en voor die boom in drag is, word 'n mienimum van uitdun van raamtakke en 'n mienimum van inkort van langlote aanbeveel. Die vorm van die toekomstige boom kan nie uit die oog verloor word nie, en 'n enkele buitensporige tak wat te veel van die groeikrag in beslag neem, kan wel verwyder word; lote wat regop groei word na 'n buite-oog of na 'n syloot ingekort, terwyl 'n ander wat plat lê, by 'n binne-oog afgesny word. Maar klem moet daarop gelê word dat alle snoei in hierdie stadium matig van geaardheid moet wees. Die fynere, tengerige lote wat in die algemeen afgesny word, moet behou word; hulle vorm blare wat vir alle bome, maar veral

vir jong bome, kostelike werk verrig. In geval daar gevaar is dat die boom te dig mag groei, kan sulke oortollige lote uitgeknip word sodra die boom die drastadium bereik.

B. *Vir Bome in volle drag.* Met die uitswel van die vrugte-oë en onmiddellik daarna, wanneer vrugte gevorm word, word baie van die energie van die boom in beslag geneem, en die boom beleef 'n besondere kritieke periode. Die uitputtende uitwerking kan op dié stadium teëgewerk word deur snoei, wat so toegepas word dat 'n groot aantal vrugte-oë afgeknip word voor hul die blomstadium bereik. Hierby word verstaan, nie die gelyk aftop van langlote wat so algemeen gevind word nie, maar 'n deeglike sisteem van uitdun van langlote, en veral ook van kortlote, wat op ou bome wat geneig is om te veel te dra, in sulke groot hoeveelhede voorkom.

'n Ander rede waarom 'n sisteem van strafsnoei vir draende bome sterk aanbeveel word, is om die beste gebruik te maak van die watervoorraad wat in die grond is. Dit is 'n vry algemeen uitgemaakte saak, dat 'n gesnoeide boom onder droë omstandighede beter resultate sal lewer as 'n ongesnoeide boom. Die oppervlakte van die boom word verklein, terwyl die wortelsisteem nie dadelik beïnvloed word nie; gevolglik is daar meer water vir die boom beskikbaar. In ons droë somer in die winter-reënval-area is genoegsaam water 'n baie belangrike saak, en ongetwyfeld die faktor wat die grootste beperkende invloed op die grootte van bome en op die grootte van vrugte uitoefen. Terwyl dus by jong bome klem gelê word op matigsnoei, word hier met nadruk gesê dat draende bome in ons klimaat kortknip vereis.

Hierdie mededeling word geëindig met 'n woord van waarskuwing. By alle bome bestaan daar 'n neiging by die oorgangsperiode tussen die stadium waar vegetatiewe groei besonder sterk is en die stadium van volle drag, om sy energie in die vorm van 'n oormaat vrugte te gebruik. 'n Ernstige stuiting in die groei van die boom op hierdie tydstip, is baie ongewens, en voorsorgmaatreëls moet geneem word by die sisteem van matigsnoei deur middel van uitpluk gedurende die vroeë somermaande, om so 'n groeistuiting en om 'n oormaat van klein vrugte te verhoed. Spesiale aandag in dié rigting moet gegee word aan swakgroeiende varieteite, soos b.v. die Bon Chretien-peer, die Roke-

wood-appel en die Kelsey-pruim. Sulke bome moet veral onder die aandag van die uitplukker kom, en moet boonop ook nog spesiale bemesting en besproeiing geniet om hul groeikrag te bevorder.

Met die toepassing van die sisteem van matigsnoei van jong bome, en 'n sisteem van kortsnoei vir bome in volle drag, wat insluit die uitpluk van vrugte in die oorgangs- en in die dra-stadium van die boom, voel die skrywer oortuig dat die opbrengs en die gehalte van vrugte per boom tot 'n buitengewone mate kan verbeter word.

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Fig. 3.—Santa Rosa-pruimboom. Kortgesnoei 1922—1927. Foto Julie 1927.

Fig. 4.—Santa Rosa-pruimboom. Kortgesnoei 1922—1927. Foto Feb. 1928.

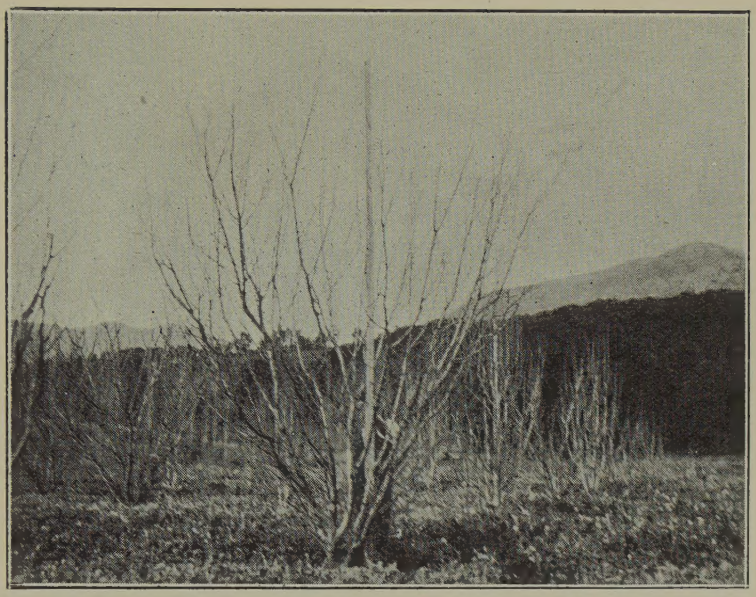
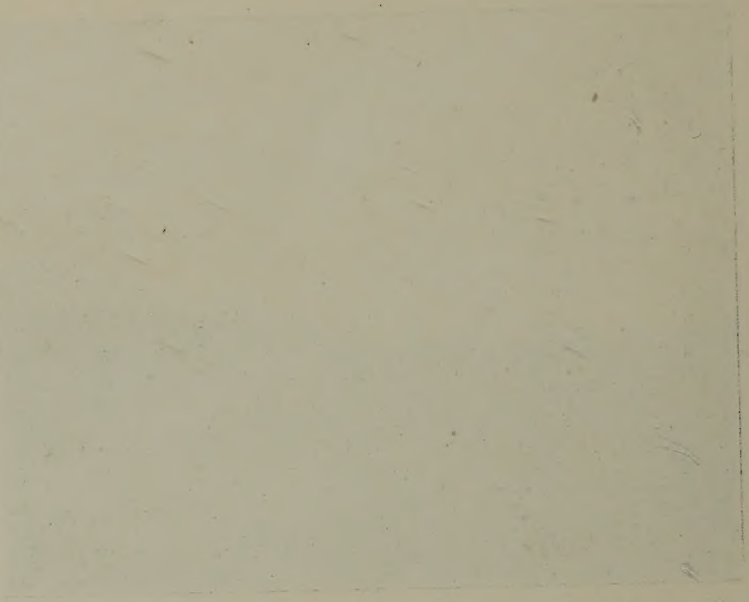


Fig. 5.—Santa Rosa-pruimboom. Matiggesnoei 1922—1928. Foto Julie 1927.
(Vergelyk met Fig. 3.)

Fig. 6.—Santa Rosa-pruim. Matiggesnoei 1922—1927. Foto Feb. 1928.
(Vergelyk met Fig. 4:)



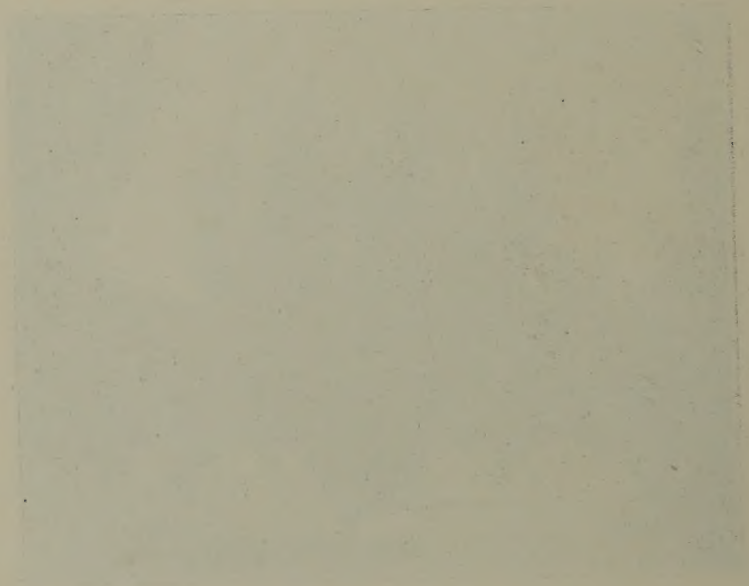


Fig. 10.—Beurre Hardy-peer. Kortgesnoei 1922—1928. Foto Julie 1927.

Fig. 11.—Beurre Hardy-peerboom. Matiggesnoei 1922—1928. Foto Julie 1927.